# the drop on water

NOVA SCOTIA

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# Contents

# Blue-Green Algae (Cyanobacteria) and Microcystins

***The maximum acceptable concentration (MAC) for total microcystins in drinking water is 0.0015 mg/L.***

Blue-green algae are microscopic aquatic bacteria that live in surface water like lakes, ponds, rivers and streams. The scientific name for blue-green algae is cyanobacteria. They may produce toxins that cause negative human health effects. An important family of toxins are called microcystins.

## Sources

Blue-green algae blooms occur in surface water systems. The toxins they produce can also impact adjacent shallow dug wells. Surface water systems may be high in nutrients, particularly phosphorus, that can promote blue-green algal growth. Sources of nutrients include:

- Runoff from different land uses:
  - Agriculture
  - Forestry
  - Residential
- Industrial effluents
- Wastewater effluent
- Faulty septic systems

Blue-green algal blooms normally occur in late summer and early fall and thrive in areas where water is shallow, warm, slow-moving and high in nutrients.

## Identifying a Blue-Green Algal Bloom

Blue-green algal blooms can look like fine grass clippings in the water or a large scum on the surface. They can be seen floating on the surface or suspended in the water column and can range in colour from turquoise to olive grey to red. It can be difficult to distinguish between green algae and blue-green algae. Positive

## QUICK FACTS

- Blue-green algal blooms typically occur between May and October.
- All algal blooms should be treated as potentially toxic until testing confirms the absence of microcystins.
- Do not drink, swim, bathe, shower, or brush your teeth with the water. Do not allow children, pets, or livestock to drink or swim in the water.
- The guideline for total microcystins in drinking water is **0.0015 mg/L**.
- Exposure to toxic algal blooms through dermal contact, inhalation or ingestion can cause health effects, including itchy, irritated skin and eyes, headaches, fever, diarrhea, abdominal pain, nausea, and vomiting.

identification is typically done under a microscope by a trained professional. Whenever a bloom is identified, the bloom should be treated as potentially toxic until positive identification and/or sampling proves otherwise.

## Acceptable Concentration

Blue-green algae can produce a family of toxins called microcystins. The Guidelines for Canadian Drinking Water Quality establish a maximum acceptable concentration of **0.0015 milligrams per litre (mg/L) for "total microcystins"**. If you suspect a blue-green algal bloom is present in your drinking water supply, an alternate source should be used until the bloom is gone and sampling confirms the absence of microcystins.

## Testing

Testing for total microcystins is recommended primarily when you suspect, or observe, a blue-green algae occurrence in your drinking water source. Only some laboratories test for total microcystins. You can contact Nova Scotia Environment for a current list. Note that the highest concentration of microcystins are released once blue-green algae cells die-off and those toxins can persist in the environment for months following a bloom. If sampling for total microcystins, Nova Scotia Environment recommends sampling once there are no longer visible signs of a bloom.

## Health Risks

Health effects can occur through dermal contact, inhalation, or ingestion of water contaminated by microcystins. Symptoms of exposure include:

- Itchy, irritated eyes and skin if you swim in contaminated water
- Headaches, fever, diarrhea, abdominal pain, nausea, and vomiting if toxins are swallowed or inhaled.

Prolonged or high exposure, such as swallowing a large quantity of toxins, may damage liver. Children are at greater risk due to their lower body weight. This is because they generally spend more time in the water than adults and are more likely to accidentally swallow contaminated water.

## How to Reduce Health Risks

- Avoid activities that increase the chance of exposure.
- Do not drink, swim, bathe, shower, or brush your teeth with the water.
- Do not allow children, pets, or livestock to drink or swim in the water.
- Be careful with recreational water activities that generate water sprays, such as motor-boating, because the toxins can be inhaled.
- Do not use herbicides, copper sulphate, or other algicides that may break open algae cells and release toxins.
- Do not cook with the water. Food may absorb toxins from the water.
- You may wash dishes or other objects, if you rinse them with uncontaminated water and dry them thoroughly.

- Do not eat the liver, kidneys, and other organs of fish caught in the waterbody as the toxins can be stored here. Be cautious about eating fish caught in water where blue-green algal blooms occur.
- Do not water your vegetable garden with the water.
- When watering non-edible plants, avoid spray drift that may affect humans, animals, and neighbouring properties through inhalation or contact.

## Treatment

Residential-scale treatment equipment is not suitable for removing toxins. If a blue-green algal bloom is suspected in your drinking water source, an alternative water source should be used.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment
and Climate Change at
1-877-9ENVIRO
or 1-877-936-8476
www.novascotia.ca/nse/water

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# Cisterns

**A cistern is a large storage tank for holding water.** Cisterns may be used as a household water supply in areas with low well capacity or poor water quality. It is normally a rectangular tank (*see Figure 1*), made of concrete or a material that has been certified to meet the current NSF standards for materials in contact with potable water. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Cisterns are often made of reinforced concrete, fiberglass, or polyethylene. If these materials do not meet the current NSF standards for materials in contact with potable water, the cistern should be lined with a material that meets the current NSF standards. Tanks are normally located underground, but can be located above the ground surface if they are in a heated structure.

The two main sources of water for filling a cistern are

- potable water hauler
- rainwater collection

Cisterns may also be filled through slow pumping from low-yield groundwater wells.

## Potable Water Hauler

Potable water haulers transport and deliver potable water in a water tank fixed to a truck. The tank should be made of stainless steel or a material that has been certified to meet the current NSF standards for materials in contact with potable water. The water tank is filled at the source and delivered to the cistern. Water supplied by a potable water hauler is often from a municipal supply. Municipal water

## QUICK FACTS

- A cistern is a large storage tank for holding water for household use.
- Cisterns may be filled by a potable water hauler or through rainwater collection.
- The size of cistern you need depends on several things, including the size and water-use habits of the household. If you are collecting rainwater, the amount of rain and the size of the collection area matters.
- Rainwater collected in a cistern must be filtered and disinfected before being consumed.
- A cistern water system must be inspected, maintained, and cleaned regularly.

**When a cistern is proposed for a new or existing building** or home, it should be indicated on the design drawing and brought to the attention of the municipality on any permit application.

utilities in Nova Scotia are responsible to make sure the water is properly managed and protected. It has been treated prior to delivery by the water hauler. Some haulers may use a public drinking water supply that is registered with Nova Scotia Environment and is monitored and tested according to the Guidelines for Monitoring Public Drinking Water Supplies. Any water hauled should be from an acceptable source of supply only and be monitored and sampled in accordance with the Water and Wastewater Facility Regulations. Best practices need to be followed for the collection, transport and discharge of water.

## Collecting Rainwater

Rainwater is captured from the rooftop of a building for storage in a cistern. Water collected from the roof may be contaminated with pollutants such as dust, metals, and bird droppings or other animal waste. Water collected in a cistern from rainwater must be filtered and disinfected before using for domestic purposes. See the Treatment section of this fact sheet for more information.

Any untreated rainwater is suitable for watering plants, lawns, etc.

## Cistern Components

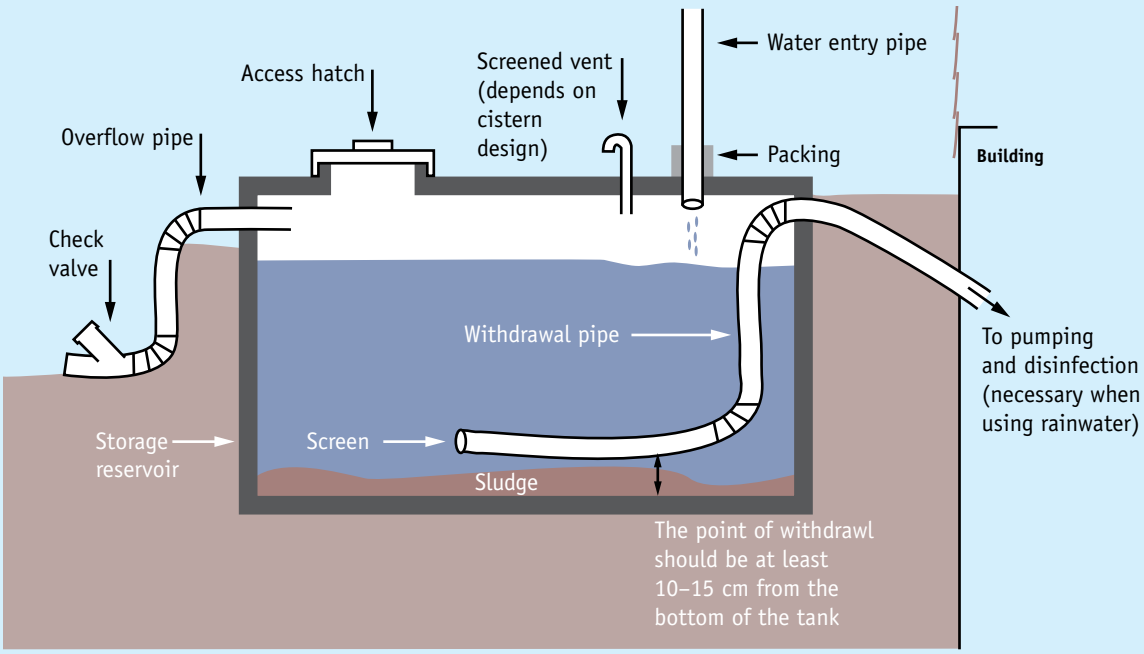
### Primary components for all cisterns:

**storage reservoir** – This is the tank in which water is stored. The recommended tank size depends on numerous factors. Minimum recommended capacity is 27,000 litres (6,000 gallons), if a cistern is your only source of water.

**screened vent** – The need for a vent depends on the cistern design. In some cases a screened vent is needed to ensure that the interior of the tank is not under pressure. The screen prevents surface contaminants from entering the water supply. The vent opening should face downward to keep airborne contaminants out of the water supply.

Figure 1 • Components of a Typical Cistern System

*Diagram not to scale.*



**access hatch** – The access hatch allows access to the cistern for inspection, maintenance, and cleaning.

**piping** – The plumbing for a rainwater cistern system is similar to that required for any other type of water supply. However, rainwater can be corrosive, with a low pH, low hardness, and alkalinity, and may leach certain metals from metal pipes into the drinking water supply. For more information, see our fact sheets on hard water, corrosive water, pH, and alkalinity at www.novascotia.ca/nse/water/thedroponwater.asp.

**withdrawal pipe with screen** – The point of withdrawal from the cistern should be at least 10–15 centimetres from the bottom of the tank. This intake height and the screen reduce the possibility of sediment intake.

**overflow pipe** – This pipe allows for spillage, by directing excess water away from the house when the cistern is full.

### Additional components for cisterns filled by rainwater:

**pre-filter** – A pre-filter is installed at a point before the water reaches the reservoir. It is normally made of sand, a nylon sock, or a geotextile material. The filter will reduce the buildup of sediment and debris in the cistern. A filter by-pass is normally also installed to allow water to flow past the filter in case the filter becomes clogged.

**downspout entry site** – This is the place where the downspout connects to the cistern. It normally has packing around it to ensure it is water-tight.

**catchment surface** – This is the collection surface from which rainfall is collected, normally the roof. Asphalt shingles, polyethylene sheathing, and fiberglass panels are all acceptable materials for roofs connected to rainwater cisterns. Metal (including galvanized metal) and cedar can both leach into the water and are therefore not recommended as roof materials for homes with rainwater collection systems.

**gutters and downspouts** – Plastic and enameled aluminum are both acceptable materials for gutters and downspouts.

## Cistern Storage Capacity and Use

Homes of two to four people need about 680 to 1360 litres (150 to 300 gallons) of water each day to meet typical water needs.

If the cistern is your sole supply of water, the recommended minimum size is 27,000 litres (6,000 gallons). To calculate the size of your cistern, you should know

- whether the water supplied by the cistern system will be used as the sole source of water or as a supplementary supply
- the size of the household using the cistern system
- the water-use habits of the household
- the size of the collection area, if collecting rainwater
- the average annual rainfall in your area, if collecting rainwater

The Centre for Water Resources Studies (CWRS) at Dalhousie University has developed software that can be used as a guide when estimating the cistern size needed, when collecting rainwater. It can be found at centreforwaterresourcesstudies.dal.ca/app/webroot/cistern. The software

You should have a good idea of the **average rainfall for your area**, because some months you may not be able to collect enough water for household use from rainfall alone. Annual and monthly precipitation information for different areas of Nova Scotia is available from Environment Canada at climate.weather.gc.ca/prods_servs/cdn_climate_summary_e.html.

has a useful instructions section. The CWRS software calculates the "% of Days Demand Fully Met". In order to meet your household demands by using rainwater as the sole source of water, the "% of Days Demand Fully Met" should be between 95 and 100%.

It is very important that you know the water use in your household because this makes a big difference in your ability to meet your water needs using a rainwater collection cistern.

## Treatment

When water supplied by a potable water hauler is obtained from a municipal drinking water supply, the municipal water utility makes sure the water is safe to drink. The water hauler is responsible for making sure the water stays safe. Homeowners are responsible for keeping the cistern clean to maintain the quality of water.

Water should never be hauled from an untreated water supply, lake, or river. This can make you sick. Surface water must be properly treated, using filtration and disinfection. See our fact sheet on surface water for more information at www.novascotia.ca/nse/surface.water/docs/SurfaceWaterQA.pdf.

Rainwater collected in a cistern must be filtered, disinfected, and tested before it is suitable for household uses such as

- drinking
- preparing infant formula
- preparing juices or ice cubes
- washing fruits and vegetables
- cooking
- brushing your teeth

In addition, many cistern supplies may need a pH adjustment, since rainwater may be corrosive towards metals in the system. For more information, see our fact sheet on corrosive water at www.novascotia.ca/nse/water/thedroponwater.asp.

### Filtration

Filtration removes certain contaminants, sediment, and unwanted tastes. A filter must be located before a disinfection unit. This is because filters may promote bacterial growth, which can then be removed by disinfection.

### Disinfection

Disinfection is essential to reduce the possibility of bacteria and pathogens being present in drinking water. The most common type of household disinfection uses ultraviolet light (UV light). Chlorine and ozone are also effective disinfection methods for microbial contamination.

Buy a treatment system that has been certified to meet the current NSF standards for the inactivation of bacteria. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

An ultraviolet light unit that is purchased for drinking water disinfection must be NSF 55 Class A approved. UV units without the Class A certification are only intended to be used for the reduction of non-pathogenic nuisance organisms. UV lights are intended for water that is visually clear (that is, not coloured, cloudy, or turbid). If the water is turbid, it should be filtered first to clarify the water.

Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the Your Well Water booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

### pH adjustments

The Canadian drinking water quality guideline for pH is an aesthetic objective (AO) of between 7.0 and 10.5. Rainwater in Nova Scotia may have a pH less than 7.0, which may contribute to the corrosion of pipes and fittings. A pH less than 7.0 is not a health risk in itself, but corrosive water can dissolve metals present in pipes, such as lead, cadmium, zinc, and copper. This may lead to increased concentrations of these metals in drinking water, which can cause health concerns. See our fact sheets on pH, lead, cadmium, zinc, copper, and corrosive water for more information at www.novascotia.ca/nse/water/thedroponwater.asp.

## Cistern Costs

Cistern costs can vary greatly depending primarily on the size and location of the cistern and the materials used. Typical costs can be between $200 and $900 for every 1,000 litres of storage capacity ($1,000 to $4,000 for every 1,000 gallons).

## Cistern System Maintenance

For the water system to continue working properly, the cistern and its components must be inspected, maintained, and cleaned regularly. You should also regularly test the water to make sure the bacterial and chemical quality is acceptable.

Whatever the source of water, water stored for more than 14 days needs chlorine bleach added to minimize bacteria and algae growth, particularly in the warmer summer months. Add 20 mL of bleach for every 1,000 litres of water (3 oz. per 1,000 gallons) in the cistern. Never use non-chlorine bleach or scented bleach to treat water.

### Storage Reservoir (Cistern)

Slime or sludge will tend to accumulate on the bottom of the cistern. This will significantly affect the water quality. The rate of accumulation will depend on

- system design
- the proximity of the cistern to vegetation (trees), if collecting rain water
- the frequency of gutter cleaning, if collecting rainwater.

Clean the cistern before the sludge buildup exceeds 2.5 cm (1 inch). The cleaning process should take place at a time when the water level in the compartment to be cleaned is minimal, to reduce the amount of water to be removed.

A cistern is considered a confined space. Only those trained in confined space entry should enter a cistern. Special equipment and a safety plan are also needed to enter and clean a cistern. Look for a cleaning company that has a confined space entry protocol and testing system in place. You can also refer to part 12 of the Occupational Safety General Regulations at www.novascotia.ca/just/regulations/regs/ohsgensf.htm.

Drain the drinking water from the cistern, including any sludge accumulation (use a wet-dry vacuum if necessary). Wash the interior surfaces with a stiff brush or pressure washer, rinse all surfaces, and drain the rinse water. Disinfect the interior of the cistern by refilling the cistern with drinking water and then adding 400 mL of unscented household bleach for every 1000mL of water. Run water through all domestic taps until you can smell chlorine in the water. This will disinfect all piping and fixtures associated with the cistern. Leave the chlorinated water in the cistern for 24 hrs to allow adequate disinfection. Do NOT USE the water in this time. Find an alternative source of water for household activities including drinking, laundry and bathing. After 24 hrs, drain the chlorinated water from the cistern, refill the cistern with drinking water and run the water taps again to rinse the system. Drinking water should be tested for bacteria before consuming.

### Roofs, Gutters, Downspouts, and Piping System (for rainwater collection)

Roofs, gutters, downspouts, and the piping system should be inspected four times a year and after severe storms for debris buildup and failure of components, such as cracked or leaking gutters and downspouts or misaligned screens.

### Pre-filter (for rainwater collection)

The pre-filter should be inspected four times a year for sediment buildup as well as the need for cleaning or replacement of filter parts.

## Considerations

Some rainwater collection systems are designed to waste the first flush of roof water, which often has more solids/debris and possibly higher concentrations of bacteria from bird droppings and other contaminants.

**Drinking Water Interpretation Tool (DWIT)**

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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# General Chemistry and Metals

**Water for drinking, cooking, and other domestic uses** should be of good quality. It should be free from organisms that may cause disease and free from chemical substances and radioactive matter that may pose a health risk. The water should be aesthetically appealing, which means that it should have no objectionable taste, smell, or colour.

Homeowners are responsible for monitoring their well water quality. Harmful bacteria or chemicals can be present in drinking water that tastes, smells, and looks acceptable. Water quality may be affected by both natural and man-made sources. Some of the potential concerns about groundwater quality in Nova Scotia include weathering and erosion of minerals and metals from certain geological formations, saltwater intrusion, de-icing road salt, sewage disposal systems, animal wastes, petroleum products, industrial effluent, landfills, and pesticides.

To ensure a well water supply is safe, it must be tested. The bacterial quality should be checked every six months. The chemical quality should be checked every two years. Frequent testing will

- check the integrity of your well
- let you know if corrective measures are required
- warn you if another activity is affecting the quality of your well water

Testing should be done earlier if changes in taste, smell, or colour are noted. Testing should also be done when the probability of contamination is greatest – after heavy rains, spring floods, extended drought, or lengthy periods of non-use.

A detailed bacterial and chemical water quality analysis allows for the following:

- an assessment of possible contaminants, such as bacteria and ammonia from sewage, chlorides from saltwater intrusion, nitrate from agricultural practices, and arsenic or uranium from naturally occurring minerals
- an assessment of potential aesthetic problems, such as hardness or staining
- a comparison to previous results

***The only way you can be sure your water supply is safe is to have it tested.***

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Testing

Regularly test your well water for bacteria and a standard suite of chemical and physical parameters. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## What should I test for?

The technical term for the things you can test for is parameters. For information on which parameters to test for, see our publication *Understanding Chemical Quality*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp. Many labs offer water quality analysis packages that are usually more cost effective than analysis of individual parameters. These packages provide more information, allowing for better interpretation of water quality results and assessment of water treatment requirements.

Included in this fact sheet are two summary tables. Table 1 is a summary of general chemistry parameters. Table 2 is a summary of naturally occurring metals found in rock, soils, and plants in Nova Scotia. These are the most frequently tested parameters offered by most labs. Some parameters included in the water quality analysis package have guideline limits and some do not. However, you should test for all of them for the following reasons:

- Their presence may interfere with the removal of health-related parameters.
- They may affect the type of treatment you select for your water supply or the treatment system's effectiveness.
- They may be indicators of overall water quality.

If you suspect that your water may be contaminated from local human activity, such as farming, septic systems, waste disposal, or underground petroleum storage tanks, then in addition to regular testing, you should test for the presence of volatile organic compounds (VOCs), pesticides, or other trace organic chemicals.

## Special Tests

Fluoride is not routinely included in the general chemistry or metals analysis. It must be specially requested. You can also request special tests for hydrogen sulphide, iron bacteria, sulphur bacteria, radon, and radium if you suspect any of these may be present in your well water.

## Guidelines for Canadian Drinking Water Quality

You will need to understand two technical terms to be able to interpret the results:

**Maximum Acceptable Concentration** (MAC) is a level that has been established for certain substances that are known or suspected to cause adverse health effects.

**Aesthetic Objective** (AO) is established for parameters that may impair the taste, smell, or colour of water or which may interfere with the supply of good quality water.

## Detection Limit

The detection limit is the lowest concentration of a chemical that can be reliably measured. It may be referred to on a lab report as DL, RDL (reporting detection limit), or RL (reporting limit).

The detection limit depends on the equipment used for analysis and the method of analysis. It can also be affected by the concentration of other parameters present in the water. For example, if the concentration of calcium is very high, it can elevate the detection limit of another parameter. To compare the concentration of a parameter to the Canadian drinking water quality guideline (if one exists), **the detection limit must be less than the guideline**.

Some labs do not report the detection limit. However, you can still determine the detection limit used for each parameter from the lab report. For example, if the detection limit of a parameter is 2 mg/L and the level of the parameter is below the detection limit, the result will be listed as "< 2" (less than 2 mg/L).

If the detection limit is greater than the guideline, you should consult the laboratory where the analysis was done. The laboratory will inform you of the options available for reporting the parameter of concern with a lower detection limit.

## Units

Laboratories may report the concentration of parameters in milligrams per litre (mg/L) or micrograms per litre (µg/L or ug/L). There is a BIG difference: **1 mg/L is equal to 1000 µg/L**.

When looking at the results from a lab and comparing them to previous results, or to the results from a different lab, or to the *Guidelines for Canadian Drinking Water Quality*, make sure the units are the same.

1 mg/L = 1000 micrograms per liter (µg/L)

1 mg/L = 1 part per million (ppm)

1µg/L = 1 part per billion (ppb)

## Interpreting Water Quality Results

Compare the results of your water quality analysis to the *Guidelines for Canadian Drinking Water Quality*. Some labs will identify the parameters that exceed the guidelines for you.

- If your water exceeds a MAC, take action to eliminate the problem or install treatment.
- If your water exceeds an AO, you may choose to treat your water for two reasons:
- to prevent staining, scaling, or corrosion of plumbing fixtures and appliances
- to make it more pleasing to consume

## Treatment

Nova Scotia Environment and Labour recommends purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, test your treated water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Health Concerns

Health effects from parameters that have a Maximum Acceptable Concentration (MAC) are outlined in Tables 1 and 2. If you have concerns about elevated levels of any parameter, including those with no Canadian drinking water quality guideline, discuss your concerns with your doctor.

## Table 1: General Chemistry Parameters

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Alkalinity (as $CaCO_3$)** | no numerical guideline | Alkalinity is a measure of the buffering capacity of water – its ability to resist sudden changes in pH. pH and alkalinity are factors in determining whether water is corrosive, scale-forming, or neutral. If water is corrosive, metals, such as lead or cadmium, may leach into the water and cause adverse health effects.<br>*See our* fact sheets on alkalinity *and corrosive water for more information.* |
| **Ammonia (as Nitrogen)** | no numerical guideline | The presence of ammonia ($NH_3$) may indicate improperly treated sewage or fertilizer or it may occur naturally. Ammonia may be converted to nitrate or nitrite. If the nitrate, nitrite, or the bacterial level is elevated, investigate the source.<br>*See our fact sheets on* nitrate *and* nitrite *for more information.* |
| **Anion Sum** | | The anion sum is the sum of the negative ions (anions) present in water. It is used to calculate the ion balance. Major contributors to the anion sum are usually alkalinity, chloride, and sulphate. The anion sum is not an indicator of water quality. It is a check of the analytical accuracy of the data. |
| **Bicarbonate and carbonate (as $CaCO_3$)** | no numerical guideline | Bicarbonate and carbonate, as $CaCO_3$, are derived from carbonate rocks, carbon dioxide ($CO_2$) in the atmosphere, and the weathering of feldspars and other minerals. Both are major contributors to alkalinity. Bicarbonate and carbonate may combine with calcium and magnesium when water is heated, forming a scale on pipes and plumbing materials. |
| **Calcium (Ca)** | no numerical guideline | Calcium is present in all natural waters. It is a major contributor to drinking water hardness. Excessively hard water can affect the function and lifetime of plumbing systems and appliances.<br>*See our fact sheets on* calcium *and* hard water *for more information.* |
| **Cation Sum** | | The cation sum is the sum of positive ions (cations) present in water. It is used to calculate the ion balance. Major contributors to the cation sum are usually calcium, magnesium, and sodium. The cation sum is not an indicator of water quality. It is a check of the analytical accuracy of the data. |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Chloride ($Cl^-$)** | AO of less than or equal to 250 milligrams per litre (mg/L) | Chloride is found naturally in groundwater. It can cause water to have a salty taste. Chloride may also be an indicator of saltwater intrusion or sewage contamination. Chloride is often the first sign of deteriorating groundwater quality.<br>*See our fact sheet on chloride for more information.* |
| **Colour** | AO of less than or equal to 15 true colour units (TCU) | Colour in drinking water may be aesthetically unappealing and is a possible indication of contamination.<br>*See our fact sheet on colour for more information.* |
| **Conductivity** | no numerical guideline | Conductivity is a measure of the ability of water to carry an electrical current. It increases as the amount of dissolved minerals (ions) increases and can signal the presence of other contaminants in water. Conductivity is one of several parameters used to indicate overall water quality. |
| **Copper (Cu)** | MAC of 2.0 milligrams per litre (mg/L) and aesthetic objective (AO) of 1.0 mg/L | Copper is naturally occurring, but the most common source of copper in drinking water is the corrosion of copper-containing plumbing materials. It is an essential element required in small amounts by all living organisms. Short-term exposure to very high concentrations of copper can cause nausea and other gastrointestinal discomforts. Long-term exposure may cause damage to the liver and kidneys. .<br>*See our fact sheets on copper and corrosive water for more information.* |
| **Dissolved Organic Carbon** | no numerical guideline | Dissolved Organic Carbon (DOC) is used to measure dissolved compounds found in water derived from plant and animal (organic) materials. DOC is one of several parameters used to indicate overall water quality. |
| **Fluoride (F)** | MAC of 1.5 milligrams per litre (mg/L) | Fluoride is naturally occurring. It may be present naturally in dissolved form in groundwater through weathering and erosion of certain rock and soil types. It may also be present in groundwater due to septic and sewage treatment effluent from areas with fluoridated water. Exposure to excess fluoride in drinking water can cause dental fluorosis. Over the long term, it can cause skeletal fluorosis.<br>*See our fact sheet on fluoride for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Hardness** | no numerical guideline, but the optimum range of hardness in drinking water is an equivalent calcium carbonate ($CaCO_3$) concentration between 80 and 100 mg/L | Hard water is caused by the presence of minerals such as calcium and magnesium in water. Hard water causes scale formation in pipes, on plumbing fixtures, and in heating systems. Hardness is one of several parameters used to indicate overall water quality.<br>*See our fact sheet on hard water for more information.* |
| **Ion Balance** | | The ion balance compares the negative ions (anion sum) to the positive ions (cation sum). They should theoretically be equal to each other, within plus or minus 5 per cent. Although unusual, if the ions are not balanced, it may indicate that an ion is present in the water that has not been accounted for. The ion balance is not an indicator of water quality. It is a check of the analytical accuracy of the data. |
| **Iron (Fe)** | AO of less than or equal to 0.3 milligrams per litre (mg/L) | Iron is a metallic element present in many types of rock. It is commonly found in water. It is an essential element required in small amounts by all living organisms. Iron can collect and block pipes or fixtures and break off as rust flakes or sediment, giving water an unpleasant appearance and taste. Health effects are not expected at levels normally found in drinking water.<br>*See our fact sheet on iron for more information.* |
| **Langelier Index** | | The Langelier Index is an approximate indicator of the degree of saturation of calcium carbonate ($CaCO_3$) in water. It is calculated using the pH, alkalinity, calcium concentration, total dissolved solids, and water temperature of a water sample. The Langelier Index was one of many indicators formerly used to assess the stability of water (whether it was corrosive or scale-forming water). It is no longer considered a good indicator of corrosion.<br>*See our fact sheet on corrosive water for more information.* |
| **Magnesium (Mg)** | no numerical guideline | Magnesium is present in all natural waters. It is an essential element required in small amounts by all living organisms. It is a major contributor to drinking water hardness. Excessively hard water can affect the function and lifetime of plumbing systems and appliances.<br>*See our fact sheets on magnesium and hard water for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Manganese (Mn)** | MAC of 0.120 milligrams per litre (mg/L) and Aesthetic Objective (AO) of 0.020 mg/L. | Manganese is a metallic element present in many types of rock. It is prevalent across Nova Scotia in surface water and groundwater. Current evidence indicates that consumption of manganese in drinking water above the MAC over a prolonged period of time can adversely affect neurologic development in children, and memory, attention and movement in adults. Manganese in water above AO levels may cause objectionable taste, smell and colour of the water as well as possible staining of laundry and bathroom fixtures.<br>*See our fact sheet on* manganese *for more information.* |
| **Nitrate ($NO_3^-$)** | The guideline depends on the method the laboratory uses to measure concentrations:<br>• nitrate measured directly – MAC of 45 milligrams per litre (mg/L)<br>• nitrate-nitrogen calculated from the total nitrogen concentration – MAC of 10 milligrams per litre (mg/L) | The presence of nitrate may indicate improperly treated sewage or fertilizer or it may occur naturally. Nitrate contamination is often one of the first signs of deteriorating groundwater quality and could indicate other problems with well water quality. Nitrate-nitrogen levels greater than 10 mg/L can pose a risk to infants up to six months old.<br>*See our fact sheet on* nitrate *for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Nitrite ($NO_2^-$)** | The guideline depends on the method the laboratory uses to measure concentrations:<br>• nitrite measured directly – MAC of 3.0 milligrams per litre (mg/L)<br>• nitrite-nitrogen calculated from the total nitrogen concentration – MAC of 1.0 milligram per litre (mg/L) | The presence of nitrite may indicate improperly treated sewage or fertilizer, or it may occur naturally. Nitrite contamination may be a sign of deteriorating groundwater quality and could indicate other problems with well water quality. Nitrite-nitrogen levels greater than 1.0 mg/L can pose a risk to infants up to six months old.<br>*See our fact sheet on nitrite for more information.* |
| **Ortho-phosphate as phosphorous (P)** | no numerical guideline | Ortho-phosphate is a chemistry-based term that refers to an inorganic phosphate. The presence of ortho-phosphate in groundwater can indicate contamination from surface water sources. Investigate the source, as the presence of pathogens or other contaminants present in surface water may cause adverse health effects. |
| **pH** | AO of between 7.0 and 10.5 | **A pH less than 7.0** may contribute to the corrosion of pipes and fittings. A pH less than 7.0 is not a health-risk in itself, but corrosive water can dissolve metals, such as lead, cadmium, zinc, and copper present in pipes. This may lead to increased concentrations of these metals in drinking water, which can cause health concerns.<br>*See our fact sheets on lead, cadmium, zinc, copper and corrosive water for more information.*<br>**A pH greater than 10.5** may contribute to scale build-up in plumbing materials. pH is one of several parameters used to indicate overall water quality.<br>*See our fact sheet on pH for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Potassium (K)** | no numerical guideline | Potassium is naturally occurring, but the most common source of potassium in drinking water are water treatment systems, such as ion exchangers (water softeners) that use potassium chloride. It is an essential element required in small amounts by all living organisms. Adverse health effects from exposure to increased potassium in drinking water are unlikely in healthy people. Potassium may cause health effects in people with certain conditions (for example, people taking certain medications for heart disease, kidney disease, pain, and HIV treatment). If water is softened by potassium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.<br>*See our fact sheet on potassium for more information.* |
| **Silica as $SiO_2$** | no numerical guideline | Silica is an abundant compound, present in groundwater through erosion of rocks and minerals. Silica is much more common in groundwater than in surface water. Dissolved silica does not have any known health concerns for humans. However, the presence of high amounts of dissolved silica may interfere with water treatment systems designed to remove dissolved iron and manganese. Extremely high dissolved silica concentrations may produce scale in pipes and restrict water flow within piping systems. |
| **Saturation pH** | | Saturation pH is a theoretical pH at which water is stable and will neither form a scale nor corrode. It is calculated using the temperature, total dissolved solids, and the calcium content and alkalinity of water.<br>*See our fact sheet on pH for more information.* |
| **Sodium (Na)** | AO of less than or equal to 200 milligrams per litre (mg/L) | All groundwater naturally contains some sodium. It is an essential element required in small amounts by all living organisms. High levels of sodium can give water a salty taste. Sodium in drinking water may cause health concerns for those on sodium-restricted diets. If water is softened by sodium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.<br>*See our fact sheet on sodium for more information.* |
| **Sulphate ($SO_4^{2-}$)** | AO of less than or equal to 500 milligrams per litre (mg/L) | Sulphate minerals in drinking water can increase corrosion of plumbing and water well materials. Sulphate is found naturally in groundwater through the weathering of rocks. At levels above 1000 mg/L, sulphate in drinking water can have a laxative effect.<br>*See our fact sheet on sulphate for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Total Dissolved Solids** | AO of less than or equal to 500 milligrams per litre (mg/L) | Total dissolved solids (TDS) is the calculated dissolved matter found in water comprised of mineral salts and small amounts of other inorganic and organic substances. It is related to the conductivity of water. TDS is one of several parameters used to indicate overall water quality. If the concentration of total dissolved solids is too high, the water is unsuitable for drinking or cooking. |
| **Turbidity** | varies, based on the source and the technology used to treat water | For surface water and groundwater under the direct influence of surface water, turbidity may indicate the presence of disease causing organisms, such as bacteria, viruses, and parasites that can cause nausea, cramps, diarrhea, and associated headaches. In secure groundwater sources, turbidity may be present due to the presence of clay, silt, and inorganic matter from natural sources. It is important to know and understand the source of turbidity.<br>*See our fact sheet on* turbidity *for more information.* |
| **Zinc (Zn)** | AO of less than or equal to 5.0 milligrams per litre (mg/L) | Zinc is naturally occurring, but the most common source of zinc in drinking water is the corrosion of galvanized plumbing and well materials. Zinc is an essential element and is generally considered to be non-toxic at levels normally found in drinking water. Exposure to very high concentrations of zinc may result in nausea and diarrhea.<br>*See our fact sheets on* zinc *and* corrosive water *for more information.* |

**Table 2: Metals**

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Aluminum (Al)** | MAC of 2.9 milligrams per litre (mg/L) | Aluminum is a naturally occurring metal that is generally found in low levels in groundwater and higher levels in surface water sources. Exposure to high levels of aluminum can cause nausea, vomiting, diarrhea, ulcers, rashes, and arthritic pain. Long-term exposure can impact the nervous system.<br>*See our factsheet on* aluminum *for more information.* |
| **Antimony (Sb)** | MAC of 0.006 milligrams per litre (mg/L) | Antimony is naturally occurring, but the most common source of antimony in drinking water is the corrosion of antimony-containing plumbing materials. Exposure to very high levels of antimony (above 30 mg/L) in drinking water can cause nausea, vomiting, and diarrhea.<br>*See our fact sheet on* antimony *for more information.* |
| **Arsenic (As)** | MAC of 0.01 milligrams per litre (mg/L) | Arsenic is a naturally occurring element present in soil and rock. Some areas of Nova Scotia have a greater potential for elevated arsenic levels in drinking water, depending on the type of minerals in the soil or bedrock. Exposure to high levels of arsenic in drinking water can cause nausea, diarrhea, and muscle pain. Over the long term, exposure to low levels of arsenic can cause certain types of cancer.<br>*See our fact sheet on* arsenic *for more information.* |
| **Barium (Ba)** | MAC of 2.0 milligrams per litre (mg/L) | Barium is a common element in the earth's crust. Exposure to high levels of barium in drinking water can cause gastrointestinal discomfort, muscular weakness, adverse effects on the kidneys, high blood pressure and/or cardiovascular disease.<br>*See our fact sheet on* barium *for more information.* |
| **Beryllium (Be)** | no numerical guideline | Beryllium is a metal found naturally in rocks, and in some precious stones such as emeralds and aquamarine. It is also found in certain industrial and municipal effluent. It is very rare for beryllium to be present in water above detectable levels. |
| **Bismuth (Bi)** | no numerical guideline | Bismuth is a metal found as crystals in nickel, cobalt, silver, and tin ores. It is usually recovered as a byproduct of lead and copper smelting. In Nova Scotia it is very rare for bismuth to be present in water above detectable levels. |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Boron (B)** | MAC of 5 milligrams per litre (mg/L) | Boron is a naturally occurring element found in rock and soil. Some boron found in groundwater is naturally occurring. It may also be present in groundwater due to industrial effluent, leaching of fertilizer, sewage, or leaching of landfill materials. Exposure to very high concentrations of boron in drinking water can cause reproductive malfunction in men and developmental abnormalities.<br>*See our fact sheet on boron for more information.* |
| **Cadmium (Cd)** | MAC of 0.007 milligrams per litre (mg/L) | Cadmium is a naturally occurring element found in very low concentrations in most rocks, as well as in coal and petroleum. The main source of cadmium in drinking water however is through contact with plumbing materials with galvanized steel/iron. Exposure to high levels of cadmium in drinking water can cause gastrointestinal discomforts, kidney damage and reduced bone density.<br>*See our fact sheet on cadmium for more information.* |
| **Chromium (Cr)** | MAC of 0.05 milligrams per litre (mg/L) | Chromium is a metal found naturally in rocks, soils, and plants. It is an essential element required in small amounts by all living organisms. Chromium compounds from natural sources are usually found in groundwater in trace amounts only. The most common man-made sources of chromium in groundwater are the burning of fossil fuels, as well as mining and industrial effluent. Chromium can be present as chromium 3 or chromium 6 in water. Chromium 3 is non-toxic, but exposure to high levels of chromium 6 in drinking water can cause kidney and liver damage.<br>*See our fact sheet on chromium for more information.* |
| **Cobalt (Co)** | no numerical guideline | Cobalt is an element that is relatively rare in groundwater. It may be released into the environment through the emissions of coal burning industries. Cobalt is not considered a health risk, because it is generally not often freely available in the environment. |
| **Lead (Pb)** | MAC of 0.005 milligrams per litre (mg/L) | The main source of lead in drinking water is through corrosion of plumbing materials with lead components, such as pipes, solder, faucets, fittings, and older galvanized well liners. Exposure to lead in drinking water can cause damage to the brain and nervous system, behaviour problems and learning disabilities, developmental delays, and hearing disorders.<br>*See our fact sheet on lead for more information.* |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Molybdenum (Mo)** | no numerical guideline | Molybdenum is a metal found naturally in small quantities in rocks and soils. It is an essential element required in small amounts by all living organisms. Sources of molybdenum in groundwater include fossil fuel combustion, sewage sludge, certain fertilizers, and mining waste. |
| **Nickel (Ni)** | no numerical guideline | Nickel is a metal found naturally in rocks, soils, and plants. In groundwater, nickel can be present through the weathering of rocks and as a result of human activities, such as the burning of fossil fuels, smelting, and the electroplating industry. Although nickel may be toxic in high concentrations, the concentrations in water are not usually high enough to cause health concerns. |
| **Phosphorous (P)** | no numerical guideline | Phosphorus is an element commonly found in soil, rocks, and plants. It is an essential nutrient for all forms of life. Phosphorus is used in agricultural fertilizers and is also present in detergents, as well as in human and animal wastes. It is much more common in surface water than in groundwater, since it is immobile and is very unlikely to reach groundwater in significant concentrations.<br>A more general concern of phosphorus is its environmental effects. Elevated levels of phosphorus may cause blue-green algal blooms in surface water. The algal blooms can affect human health through contact or consumption. For more information on algal blooms,<br>*See our fact sheet at* www.novascotia.ca/nse/water/docs/BlueGreenAlgae.pdf |
| **Selenium (Se)** | MAC of 0.05 milligrams per litre (mg/L) | Selenium is found naturally in small quantities in rocks and soils. It is an essential element required in small amounts by all living organisms. Selenium may be present naturally in dissolved form in groundwater through weathering and erosion of certain rock and soil types. Other sources of selenium in groundwater include contamination from industrial effluent, municipal wastewater, and hazardous waste sites. Exposure to very high levels of selenium (above 9 mg/L) in drinking water can cause fatigue and irritability, as well as damage to hair, fingernails, and liver tissue.<br>*See our fact sheet on* selenium *for more information.* |
| **Silver (Ag)** | no numerical guideline | Silver is a relatively rare metal. The major commercial uses of silver are in photography, electronic components, and in the manufacturing of metal alloys. Silver may be adsorbed by soils, but is very immobile and is unlikely to be present above detection limits in groundwater. |

| Parameter | Guidelines for Canadian Drinking Water Quality | Comments |
|---|---|---|
| **Strontium (Sr)** | MAC of 7.0 milligrams per litre (mg/L) | Strontium is a naturally occurring element found in groundwater and surface water sources through weathering of rocks and soils or as a result of human activities such as mining and manufacturing operations . Exposure to elevated levels of strontium can cause adverse effects to bone development. *See our fact sheet on* strontium *for more information.* |
| **Thallium (Tl)** | no numerical guideline | Thallium is naturally present in rocks. The most common source of thallium in groundwater is through the leaching of thallium from ore processing operations. In Nova Scotia, thallium may be present in soils near abandoned gold mine tailings. |
| **Tin (Sn)** | no numerical guideline | Tin is a metal found in many rocks and minerals. It is rare for tin to be naturally present in soils and water. Most tin present in groundwater is due to manufacturing and industrial effluent. |
| **Titanium (Ti)** | no numerical guideline | Titanium is an element found naturally in many igneous and sedimentary rocks. Titanium compounds are stable in soil, so only small amounts of titanium end up in water from the weathering of rocks. Titanium may also be present in groundwater due to manufacturing effluent. Titanium is relatively non-toxic. It does not accumulate in the human body. |
| **Uranium (U)** | MAC of 0.02 milligrams per litre (mg/L) | Uranium is a naturally occurring radioactive element that exists in soil and rock throughout the world. Some areas of Nova Scotia have a greater potential for uranium levels in drinking water to exceed the guideline, depending on the type of minerals in the soil or bedrock. Exposure to uranium in drinking water can result in kidney damage. *See our fact sheet on* uranium *for more information.* |
| **Vanadium (V)** | no numerical guideline | Vanadium is found naturally in small quantities in rocks and soils. The presence of vanadium in well water depends on the rock and soil type in the area. Other human-related sources of vanadium are from emissions from the production of oil, gas, and metal alloys. |

## Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Ground Source Heat Pumps

## What are ground source heat pumps?

Ground source heat pumps are heat pumps that transfer heat to or from the ground and use it for heating or cooling buildings. They are also commonly referred to as geothermal heat pumps, groundwater heat pumps, geo-exchange systems, and earth energy systems.

## What are the advantages of ground source heat pumps?

Ground source heat pumps use a renewable, cost-effective, alternative energy source that can help reduce greenhouse gas emissions. They are currently being used in residential, commercial, and institutional buildings in Nova Scotia and elsewhere. The use of these systems is expected to grow because of increasing energy costs and concerns about greenhouse gas emissions.

## What are the different types of ground source heat pumps?

A variety of ground source heat pump designs and technologies are available. They can be grouped into two main types of systems: open-loop (*see Figure 1*) and closed-loop (*see Figure 2*).

An open-loop system (water well system) pumps groundwater from a supply well, passes the water through a heat pump to transfer the heat, and then discharges the water to a return well or discharge well. This type of system typically uses at least two wells, one for supply and one for discharge.

## QUICK FACTS

- Ground source heat pumps transfer heat to or from the ground and use it for heating or cooling buildings.
- The two main types of ground source heat pumps are open-loop and closed-loop systems.
- Ground source heat pumps use a renewable energy source that can help reduce greenhouse gases.
- Ground source heat pumps should be designed and installed by qualified and experienced contractors.
- Follow regulations and best management practices for the installation and operation of ground source heat pumps to minimize environmental impacts.

Figure 1 • An Example of an **Open-loop** Ground Source Heat Pump System

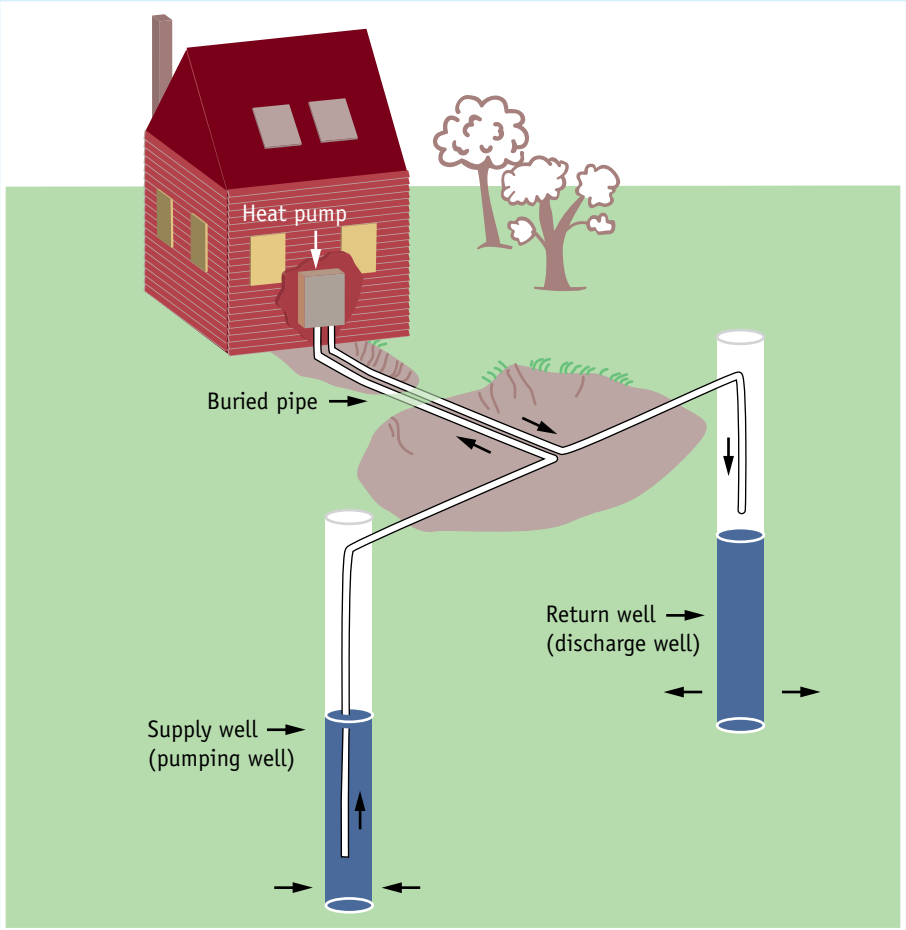
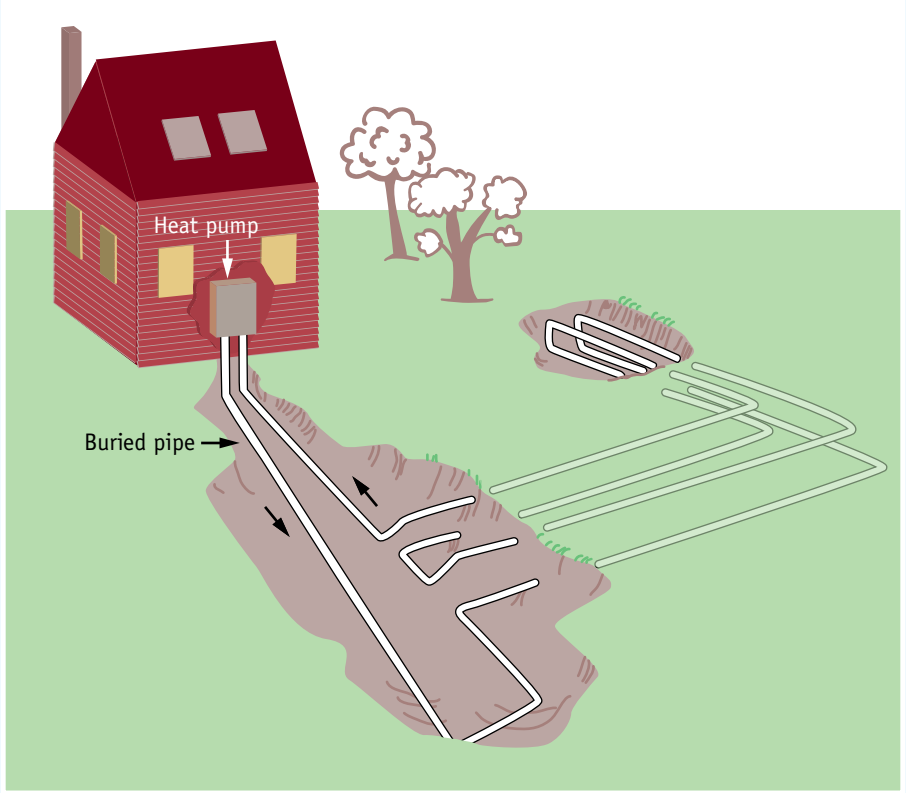



Figure 2 • An Example of a **Closed-loop** Ground Source Heat Pump System



A closed-loop system has a loop of pipe buried in the ground or installed in a borehole. The system circulates antifreeze fluid through the loop of pipe. The fluid is sealed in a pipe and never comes into direct contact with the ground. These systems do not pump any water out of the ground. A closed-loop system in a shallow trench is called a horizontal loop system. A closed-loop system installed in a borehole, or series of boreholes, is called a vertical loop system.

## Are they safe for the environment?

Ground source heat pump systems are environmentally safe when they are designed, installed, and operated properly. Two potential environmental concerns exist:

- Well interference effects – Pumping from an open-loop heat pump may cause the water level to drop in a nearby water well.
- Groundwater contamination – Groundwater may become contaminated either by the accidental release of antifreeze fluids to the ground or by changing the chemical and physical properties of the groundwater.

To avoid these potential environmental problems, ground source heat pumps should be designed and installed by qualified and experienced contractors following the regulations and best management practices described below. Contractors should be CGC Accredited (Canadian GeoExchange™ Coalition Accreditation or similar).

## What regulations apply?

Open-loop systems use water wells. Wells must be constructed by a licensed well contractor who follows the Well Construction Regulations. In addition, open-loop systems that pump more than 23,000 L/day from a supply well must have a Water Withdrawal Approval under the Activities Designation Regulations. This approval is needed even if the water is pumped back into the aquifer through a return well.

Closed-loop systems are not currently governed by any specific regulations in Nova Scotia, but we recommend the best management practices listed below.

## What best management practices are used in Nova Scotia?

- Design and install systems in accordance with the CSA standard for Design and Installation of Earth Energy Systems (CSA C448).
- Ensure that the system is designed and installed by a qualified and experienced contractor.
- Properly seal and backfill wells, boreholes, and trenches.
- Install systems as far away as possible from other water wells and sources of contamination.
- Check with local authorities to see if they have any other specific requirements, such as building codes.
- Record the location and construction details of the underground portions of the system.

- Monitor, maintain, and inspect the system regularly.
- In open-loop systems, return groundwater to the same aquifer. The water quality should be unchanged, except for temperature.
- In closed-loop systems, use antifreeze solutions that meet the CSA standard, such as ethanol, propylene glycol, and methanol.

## Where can I get further information?

- The CSA standard for Design and Installation of Earth Energy Systems can be obtained from the Canadian Standards Association at www.csa.ca.
- A Buyer's Guide for Residential Earth Energy Systems is available from Government of Canada Publications at publications.gc.ca/collections/Collection/M92-236-2001E.pdf.
- Canadian GeoExchange™ Coalition can be contacted through their website at www.geo-exchange.ca.
- To search for contractors licensed to construct water wells in Nova Scotia visit: www.novascotia.ca/nse/cms/Search.asp.
- Information on Surface Water Heat Pumps can be found here.

### Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Natural and Roadside Springs

**A natural spring** is a place where groundwater flows to the surface and discharges freely from the ground.

## History of natural and roadside springs

Roadside springs in Nova Scotia often served as a place of rest and refreshment for travelers and their horses before automobiles and convenience stores were common on Nova Scotia's highways.

Before modern well drilling equipment, natural springs were also used as a source of drinking water for many without other alternatives.

Many people still use natural or roadside springs as a source of drinking water, but natural and roadside springs are not considered to be a reliable, safe water supply.

## Springs are not monitored or treated

There is a general public perception that spring water is pure, natural, better tasting, and free of contaminants compared to local municipal water supplies or private wells. In most cases, these perceptions are not scientifically valid.

Groundwater may be relatively pristine, but as it passes through soil, sand, and gravel on its way to the surface, it can become contaminated by surface runoff and other natural or man-made sources.

Most natural or roadside springs are not routinely tested or monitored. They are generally not adequately constructed to protect against surface contaminants.

## QUICK FACTS

- Natural and roadside springs are not reliable, safe water supplies.
- Most natural or roadside springs are not routinely tested or monitored.
- Springs may be located near sources of surface water or groundwater contamination.
- Studies of roadside springs in Nova Scotia found that about 90 per cent had total coliforms present and 20 per cent had Escherichia coli (E. coli) bacteria present.
- Private well owners are able to monitor the water quality of their own wells.
- If the water from a private well is not adequate for consumption, homeowners have several options for ensuring their water is safe to drink.

**Using a natural or roadside spring as a source of water is NOT a safe option.**

## Bacterial contamination

Total coliform bacteria are used as an indicator of the general quality of the water and the potability of drinking water. The presence of total coliforms means the spring is in contact with surface water that may contain disease-causing organisms, such as bacteria, viruses, and parasites. Studies of roadside springs in Nova Scotia found that about 90 per cent had total coliform bacteria present and 20 per cent had *Escherichia coli* (*E. coli*) bacteria present. *E. coli* is a bacterium that is commonly found in the intestinal tract and feces of warm-blooded animals.

The presence of *E. coli* bacteria indicates that the source of water has been affected by recent faecal contamination and therefore the water is unsafe to drink. Some *E. coli* strains are pathogenic and cause bloody diarrhea, food poisoning, urinary and digestive infections, and in extreme cases, death in humans.

The results of total coliform and *E. coli* bacteria vary seasonally and may be higher after a heavy rainfall, snow melt, or other unusual events.

## Chemical contamination

Springs may be located near sources of surface water or groundwater contamination, such as storage tanks, septic systems, hazardous waste sites, or landfills. Water in a natural spring may become contaminated when man-made products such as gasoline, oil, road salts, and chemicals leach into surface water or groundwater, making it unsafe for human consumption.

## Safe options

Drinking water obtained from a municipal water system or a properly constructed, maintained, and monitored private well (a drilled well or a dug well) are considered safer options than natural or roadside springs.

Municipalities that obtain their drinking water from wells treat the water before distribution and consumption by consumers. They also regularly monitor the quality of the water.

Private wells are specifically constructed to ensure that the risk of surface water contamination of the water supply is minimized. If water from a private well is found to be contaminated after bacterial and chemical testing through an accredited laboratory, homeowners have several options for ensuring the water is safe to drink. Some of these options are to

- remove the source of contamination, if possible
- reconstruct the existing well
- construct a new well
- install a treatment system to treat specific problems
- use an alternate source of water, such as bottled water or another well that has been tested and found to be safe

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NOVA SCOTIA

# Protecting Your Drinking Water

**It's your responsibility as a homeowners to maintain your water well**. Protecting your water source and water supply system must be your prime consideration. Protection starts with proper location and construction of the well.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

If your drinking water is supplied by a private well, below are some measures you can take to protect your water supply.

## Inspect your well once a year

Check each of the following at least once a year, but preferably more often, for both drilled wells and dug wells:

- The wellhead is visible, not buried, and extends at least 152 millimetres (6 inches) above grade. If it is buried, contact a well contractor for help.
- The well cap is present and securely in place.
- The well cap is not broken, damaged, or cracked.
- The vent in the cap is screened and the screen is intact and not blocked by vegetation.
- All connections into the cap and well are properly sealed.
- Surface drainage near the well is directed away from the well casing or crocks.
- Surface water does not pond near the well.
- No settling or cracking of surface seals is visible.
- The pump and plumbing system are functioning properly.

*See Figure 1 for a drilled well and Figure 2 for a dug well.*

In addition,

**For dug wells, ensure that**

- The crocks and covers are secure with no holes, cracks, or broken pieces.
- Joints and connections in the crocks and liner are not leaking.
- The vent, if one is present, is not damaged or blocked. For a dug well, the vent is optional.
- No staining is visible above the apron – visible staining usually indicates a leaking joint or seal.

**For drilled wells, ensure that**

- The well casing has no holes or cracks – the part that is visible above ground.
- No gaps are visible between the casing and the ground around it.

If you note any problems, contact a certified well contractor. To search for a certified well contractor in Nova Scotia visit: www.novascotia.ca/nse/cms/Search.asp.

Figure 1 • Cross-section of a typical **drilled well**
*Diagram not to scale.*

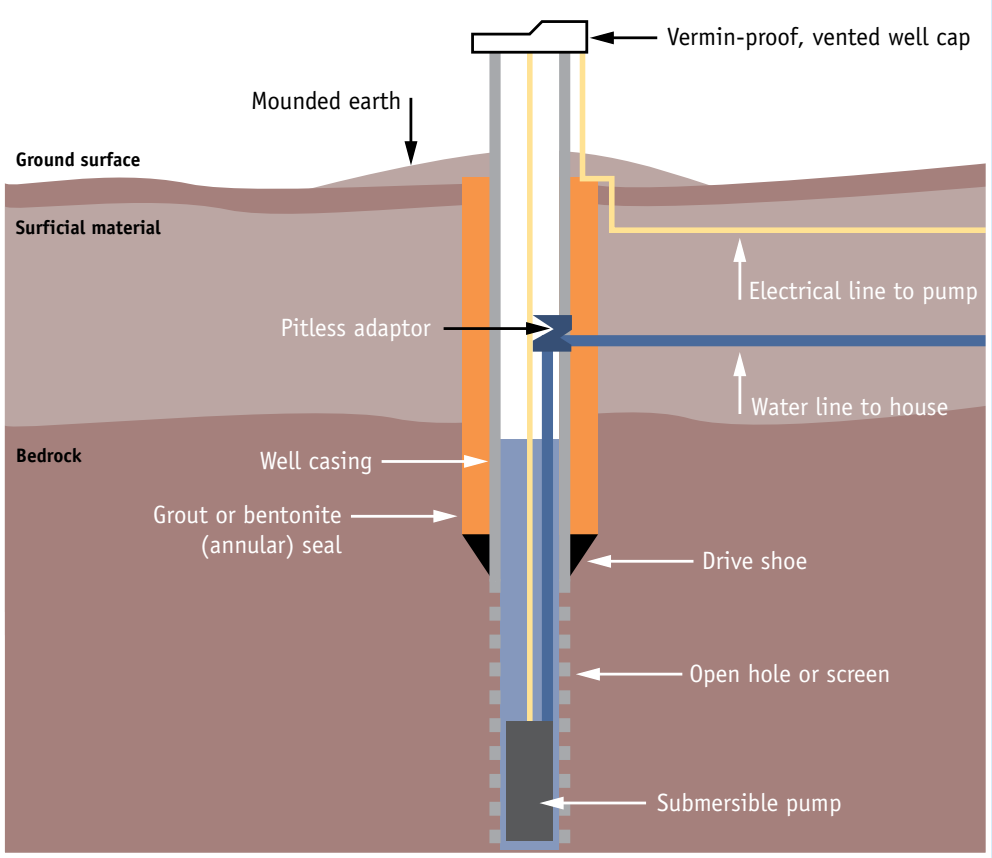
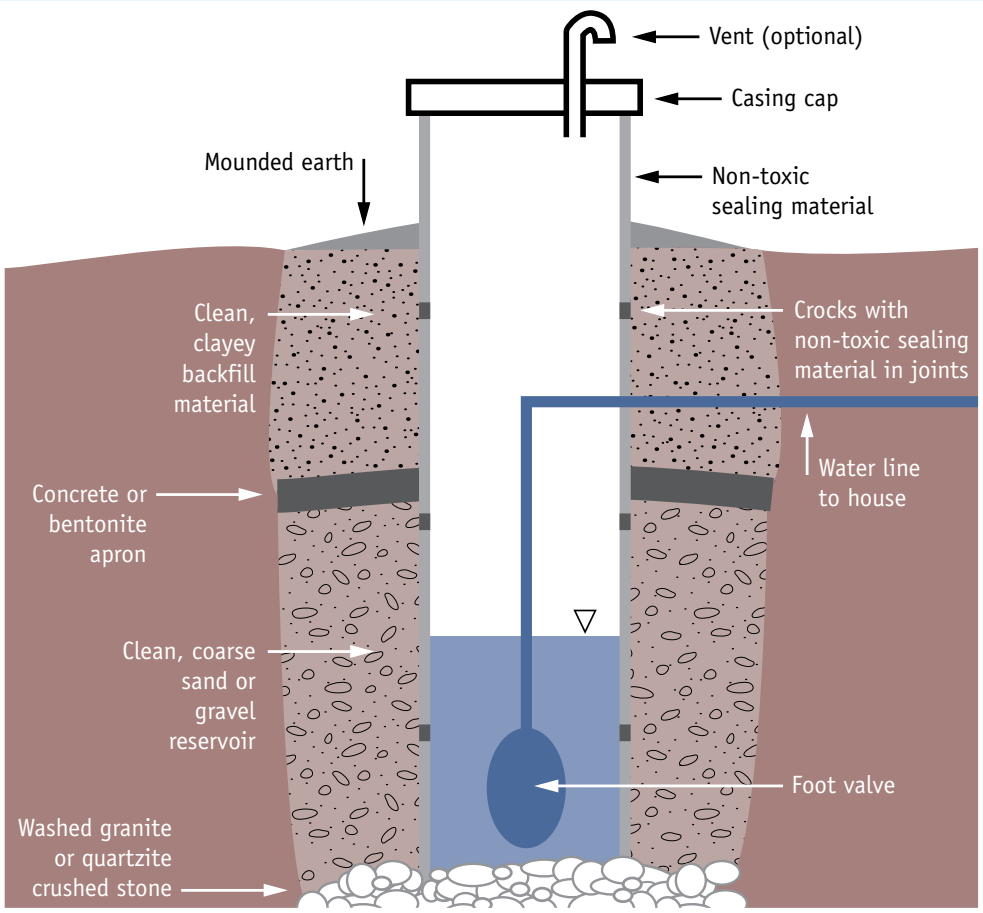



Figure 2 • Cross-section of a typical **dug well**
*Diagram not to scale.*



## Test water quality regularly

Homeowners are responsible for monitoring the quality of their well water. Investigate changes in the quantity or quality of the water immediately, and take action to correct problems.

Test the bacterial quality of your well water every six months. Test the chemical quality of your well water every two years. Test more frequently if you notice changes in taste, smell, or colour.

Collect water samples when the probability of contamination is greatest – after heavy rains, spring floods, extended drought, or lengthy periods of non-use.

Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

Ensure that chemical and microbiological parameters meet the levels recommended by the Guidelines for Canadian Drinking Water Quality. This will help reduce the risk of short and long term illnesses.

## Prevent well problems

The following simple rules will help ensure that your well provides water of good quality.

### General

- Observe minimum distances of wells to oil and septic tanks and to other potential contaminant sources, such as those listed in the Well Construction Regulations – www.novascotia.ca/just/regulations/regs/envwellc.htm
- Install an approved vermin-proof cap with a shielded and screened vent. This prevents debris, vermin, and insects from entering your well.
- Disinfect your well, pump, and pipes every time the pump or lines are removed for any reason, or repair work is carried out on the well. Chemical disinfection or chlorination ensures that your well, pump, and pipes are free from bacteria that can be introduced during well construction, pump installation, and well or pump repair.

### Landscape and Vegetation

- Grade the area around the well to promote surface drainage away from the well and prevent ponding of water.
- Grow a grass buffer around the well. Don't use or store fertilizers, pesticides, or herbicides near your well. These can leach into the groundwater supply. This is especially important for homes with dug wells.
- Do not use bark mulch and wood chips near the well – they may release chemicals into the water as they decompose.
- Do not bury brush piles, stumps, or other such debris near a dug or drilled well.

### Chemicals

- Do not allow liquids or wastes from contaminant sources such as garbage and manure piles to drain towards the well.
- Do not mix or use fuels, degreasers, waste oils, and other pollutants near the well. Spillage can contaminate the well.
- Never dispose of chemical wastes in unused wells. Dispose of such substances at the proper facilities.

### Waste

- Keep animals from urinating or defecating near the well.
- Never dispose of hazardous chemicals in a septic system. Do not flush oils, detergents, paints, solvents, or other chemicals down the toilet.
- Have your septic systems pumped and inspected every three years by a qualified person. For a list of qualified persons see our website at novascotia.ca/nse/wastewater/onsitesewage.asp.

### After a flood

- Stay away from the well pump while it is flooded to avoid electric shock.
- Do not drink or wash from the flooded well. You may become sick.
- Get help from a certified well or pump contractor to clean and turn on the pump.
- After the pump is turned back on, pump the well until the water runs clear to rid the well of flood water.
- Test the chemical and bacterial quality of your water to ensure it is safe to drink.

## Hire certified well contractors

When constructing, modifying, or decommissioning a well, hire a certified well contractor to minimize contamination of your well water.

## Keep accurate records

Accurate records, kept in a safe place, will help identify any problems that may occur. Keep each of the following:

- well and water line location
- well construction contract
- well and pump installation records
- maintenance records, such as disinfection, sediment removal, pump repair or replacement, and special procedures such as liner installation and hydraulic fracturing
- any use of chemicals in the well or treatment system
- water quality test results

For more information on well records, see our publication *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

If you follow these guidelines, your well should provide good quality water for a long time.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Rain Barrels

A **rain barrel** or rainwater barrel is a device designed to store water.

**A rain barrel is a storage tank normally located at the end of a downspout** that directs rain from the roof of a building (*see Figure 1*). The water collected in the rain barrel has not been properly filtered and disinfected, so it is not recommended for use as a drinking water source. It is ideal for watering lawns and gardens.

## QUICK FACTS

- A rain barrel is a storage container for holding rain water for household purposes such as gardening.
- Rain barrels should be made of a material that has been certified to meet the current NSF standards for materials in contact with water.
- More than one rain barrel may be useful, depending on the amount of water being collected.
- Inspect, maintain, and clean rainwater barrel systems regularly.

Rain barrels are easy to install and easy to maintain.

The cost of the barrels is fairly low and they can do many of the following:

- reduce runoff, since the water slowly seeps into the ground when used for gardens and lawns
- reduce the use of treated, potable water for outdoor uses, such as watering plants
- reduce domestic water use
- reduce energy consumption that would normally be required to treat and pump water and wastewater
- promote gardening

## Components

Figure 1 shows the main components of the barrel system.

**tank** – average capacity is between 200 and 400 litres (50–100 gallons)

**cover** – has a hole to allow connection to the downspout; as a safety precaution, make sure the cover is secure.

**sediment and insect screen or filter** – this feature may be optional, but will keep debris out of the water; debris may clog the equipment

**overflow outlet** – when the tank is full, the overflow outlet diverts additional water to a specific area, such as a rain garden or other feature designed to let rainwater infiltrate slowly into the ground

**valve** – can be opened and closed to allow water to be released from the barrel

**hose adaptor** – located at the bottom of the tank. It connects to the garden hose to distribute the water in the garden, etc.

## Materials

Rain barrels are commonly made of fiberglass, ceramic, or plastic. Some materials may leach chemicals into the water that may harm the plants in your garden. Make sure the material is certified to meet the current NSF standards for materials in contact with water.

NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

## Size

Estimate the volume of water available for collection with the following formula:

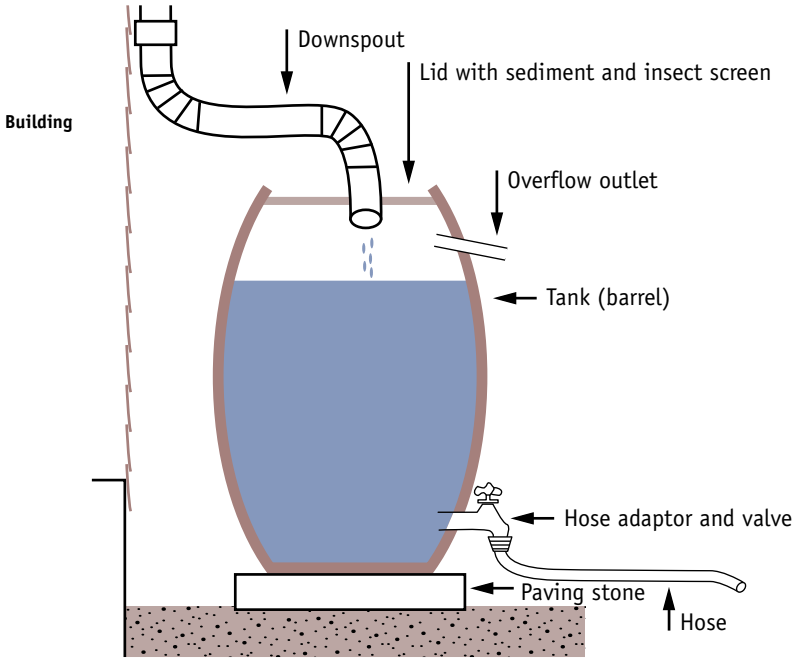
**surface area of roof × depth of rain = volume of water falling on roof**

Where the units for the equation are

- surface area of roof is in square metres (m2)
- depth of rain is measured in millimetres (mm)
- volume of water falling on roof is in litres (L)

*Example:* a rainfall of 20mm will produce over 2,000 litres of water on a roof measuring 100 square metres.
**100m2 x 20mm = 2,000 litres**

Figure 1 • Rain barrel system




You can often capture 95 per cent of the rain that falls on your roof using a rain barrel, depending on the slope of the roof and exposure to winds. A large roof may need more than one rain barrel to capture all available rain.

## Costs

Rain barrels cost between $100 and $500, depending on the size, features, and manufacturer.

## Maintenance

Keep the rain barrel system working properly with the following regular maintenance:

- Keep gutters and downspouts clear of leaves and debris to prevent clogging
- Drain your rain barrel before each rainfall to minimize overflows, particularly before heavy rains
- Drain and disconnect your barrel before the winter—freezing water may crack the barrel.

## Considerations

Use collected water regularly to minimize overflows.

Install the rain barrel on a sturdy, level surface, such as a patio or paving stones. A rain barrel can weigh up to 500 kg (1,200 lbs) when full.

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NOVA SCOTIA

# Sources of Drinking Water

**Did you know that 40 per cent of Nova Scotians get their water privately** – from a drilled well, a dug well, or a surface water source? The other 60 per cent rely on a municipal water system.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

Drilled and dug wells get their water from groundwater, which is water that is stored below the earth's surface.

## Drilled Wells

Drilled wells usually obtain water from deep aquifers. *See Figure 1*. A typical depth is about 60 metres (200 feet). When a drilled well is constructed, a hole is bored into the aquifer. The upper part is lined with casing to prevent the collapse of the borehole walls.

The following well components, shown on Figure 1, are critical in a drilled well for preventing surface and subsurface contaminants from entering the water supply:

- casing
- drive shoe
- annular seal
- vermin-proof, vented well cap

The casing also provides a housing for the pumping mechanism and the pipe that takes water from the well to the home.

## Dug Wells

A dug well consists of an excavation into a shallow aquifer. *See Figure 2.* The typical depth of a dug well is 4.5 to 8 metres (15 to 25 feet). The excavation is lined with concrete crocks, which prevent the collapse of the excavated walls.

The following well components, shown on Figure 2, are critical in a dug well for preventing surface and subsurface contaminants from entering the water supply:

- crocks
- non-toxic seals
- apron
- casing cap

For more information on drilled or dug wells, see our publication *Before You Construct a Water Well* at www.novascotia.ca/nse/water/privatewells.asp.

Figure 1 • Cross-section of a typical **drilled well**

*Diagram not to scale.*

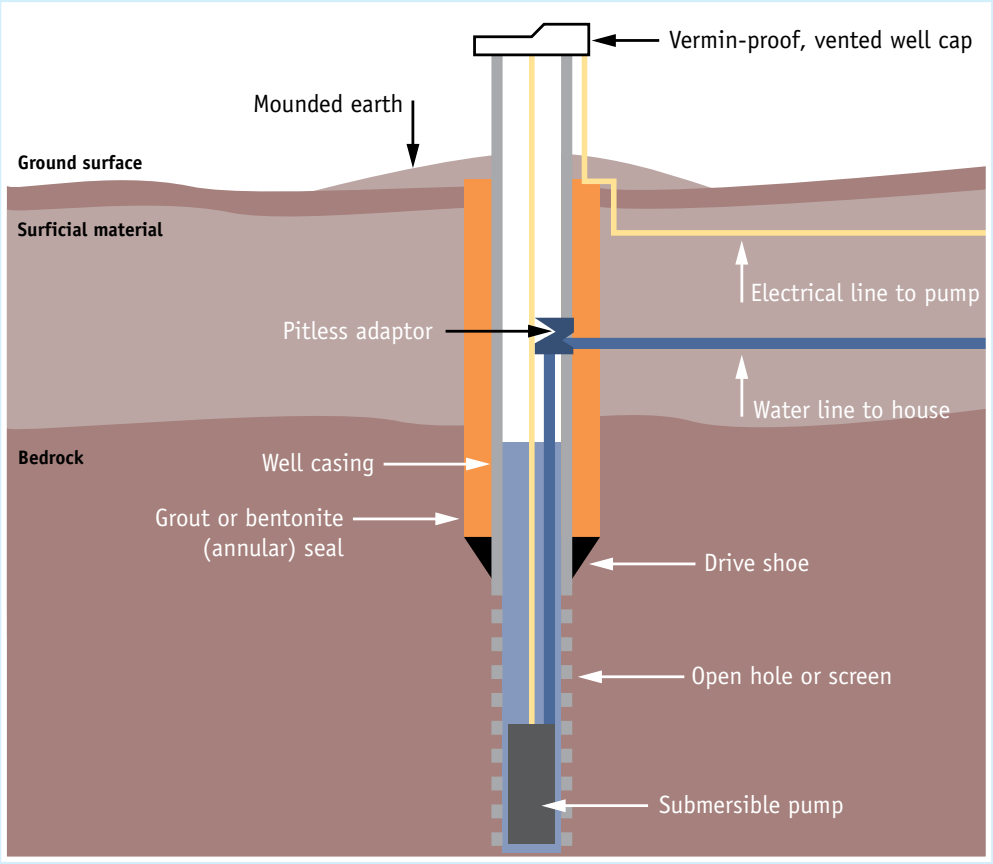
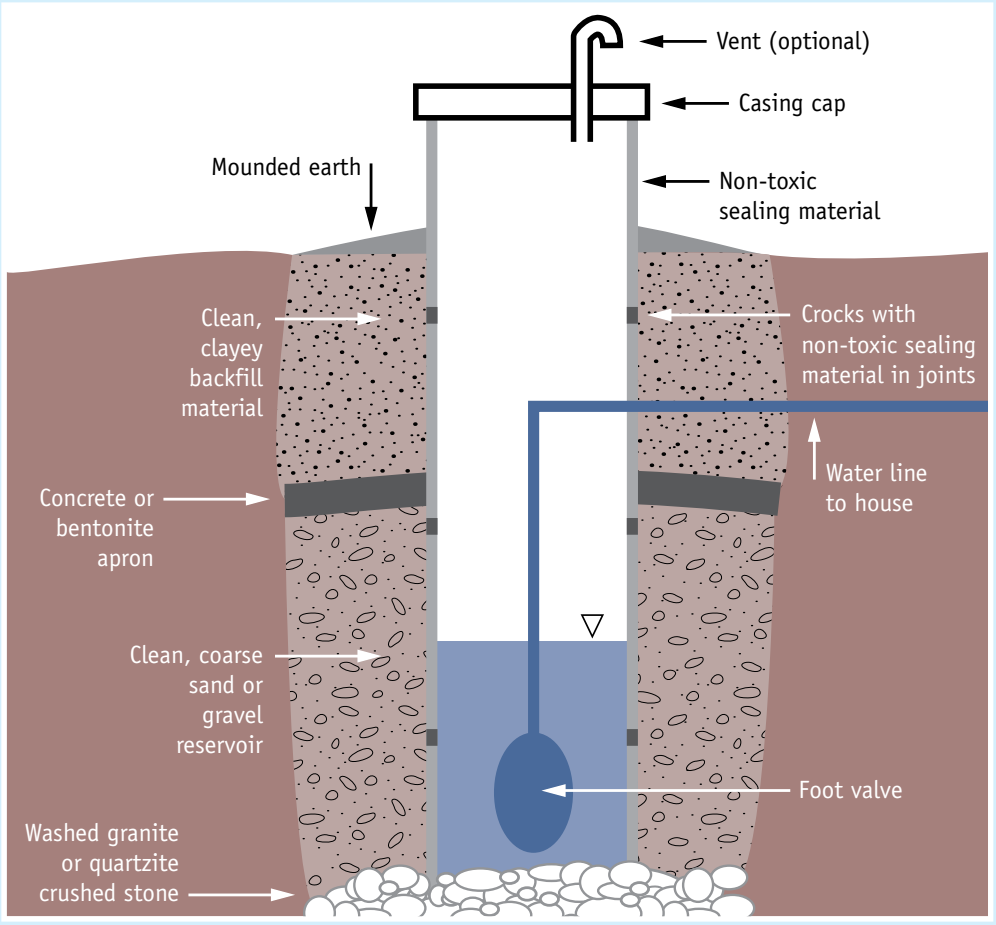



Figure 2 • Cross-section of a typical **dug well**

*Diagram not to scale.*



## Surface Water

Surface water is water found in lakes, streams, and rivers. It is not recommended as a private drinking water source unless properly filtered, disinfected, and monitored for water quality.

For more information on surface water as a private drinking water source, see our surface water fact sheet at www.novascotia.ca/nse/water/surfacewater/docs/SurfaceWaterQA.pdf.

## Advantages and Disadvantages of Each Water Source

The table on the following pages outlines the advantages and disadvantages of each water source.

Whether your source of drinking water is a drilled well, a dug well, or a surface source of water, ensure that

- Your water is of good quality, free from organisms that may cause disease and from chemical substances that may pose a health risk.
- Your water is aesthetically appealing, which means that it is free from objectionable taste, smell, and colour.
- You have sufficient water to meet household needs.

## Considerations

To determine the best source of water for your home, consult a qualified well contractor or water professional.

Qualified persons installing, maintaining or repairing a well should be familiar with the Nova Scotia Well Construction Regulations at www.novascotia.ca/just/regulations/regs/envwellc.htm.

| | Advantages | Disadvantages |
|---|---|---|
| **Drilled Well** | • can access deeper, confined aquifers<br>• increased protection from surface sources of contaminants and bacteria<br>• reduced vulnerability to drought conditions (but not eliminated)<br>• can often find water bearing fractures with depth, regardless of location<br>• can increase depth of well to increase water column and/or available storage<br>• higher maximum yields (for public or industrial supplies) | • cost of installation is usually higher than for dug wells<br>• can penetrate formations that yield water of undesirable quality<br>• health related contaminants, such as arsenic or uranium, that are more common in bedrock formations can be present, requiring treatment<br>• maximum yields are sometimes low even at depth, depending on geologic conditions<br>• drawdown can be large causing adjacent wells to interfere with each other, mainly in aquifers with low permeability<br>• higher electricity cost of pumping deep water |
| **Dug Well** | • usually less expensive than drilled wells<br>• draw water from sand and gravel deposits that are less likely to contain contaminants associated with bedrock aquifers<br>• it may be easier to find a well digger than a well driller, since there are usually more well diggers within a community<br>• large storage volume in crocks and gravel reservoir (which helps off-set the limited water column) | • usually installed in unconfined aquifers, which may be more susceptible to contamination from surface and near-surface sources, such as from septic systems (especially bacteria)<br>• affected by seasonal water table fluctuations<br>• possible only if the water table is relatively high on the property to be serviced<br>• well can run dry with high water use<br>• maximum depth limited by method of installation<br>• water seeps in only through base and joints of well<br>• maximum yields are often low in Nova Scotia due to the prevalence of clayey glacial till<br>• well construction often not sufficient to prevent vermin from entering well, which may lead to bacterial contamination<br>• ultraviolet light water disinfection is often recommended due to the higher potential for bacterial contamination |

| | Advantages | Disadvantages |
|---|---|---|
| **Surface Water** | • may not have a restricted capacity | • surface water sources contain micro-organisms, such as bacteria, viruses, and parasites, that can cause cramps, nausea, vomiting, and diarrhea, and in some cases more serious, or even fatal, illnesses<br>• requires filtration and disinfection to be properly treated for domestic use<br>• greater system maintenance required<br>• high operational cost |

## Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Surface Water Heat Pumps

## QUICK FACTS

- Surface water heat pumps transfer heat to or from a surface water body and use it for heating or cooling buildings.
- The two main types of surface water heat pumps are open-loop and closed-loop systems.
- Surface water heat pumps use a renewable energy source that can help reduce greenhouse gases.
- Surface water heat pumps should be designed and installed by qualified and experienced contractors.
- Follow regulations and best management practices for the location, design, installation, operation, and maintenance of surface water heat pumps to minimize environmental impacts.

## What is a heat pump? Is it geothermal?

A heat pump transfers heat from air, earth, or water and uses this to heat or cool a building. The energy produced from this technology is called geothermal because it is produced from earth-related or geological heat sources.

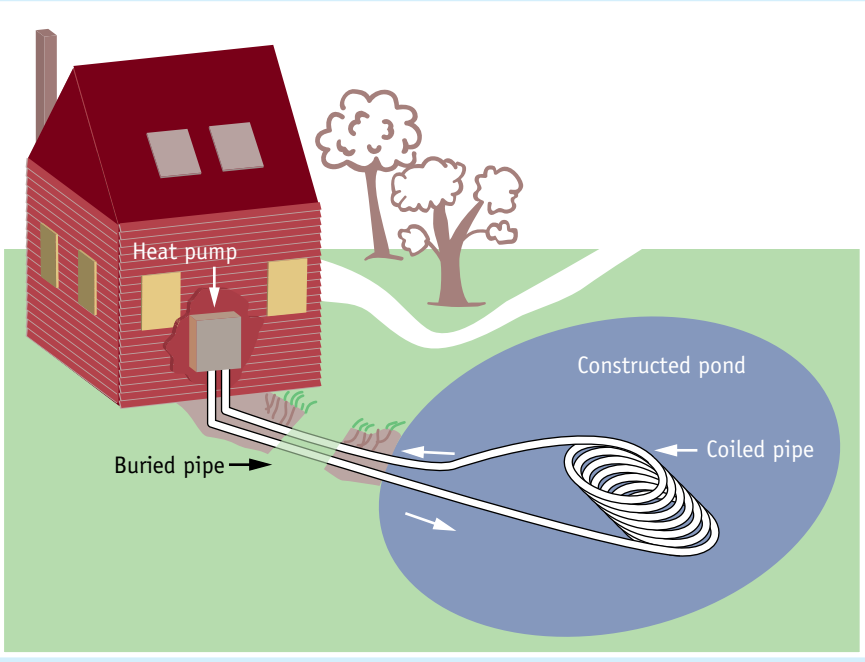
## What types of surface water heat pumps exist?

Two types of surface water heat pumps exist: **closed-loop and open-loop**. Both have advantages and disadvantages. The best choice depends upon environmental circumstances.

A **closed-loop** surface water heat pump system (*see Figure 1*) transfers heat to or from a surface water body by circulating a heat transfer fluid in an enclosed pipe. A closed-loop system is immersed in a surface water body, such as a constructed pond.

Figure 1 • Example of a **Closed-Loop** Surface Water Heat Pump System

*Diagram not to scale.*



An **open-loop** heat pump system (*see Figure* 2) withdraws water from a surface water supply, passes it through a heat exchanger, and discharges the water to a surface body of water or a storm sewer.

## What are the advantages of heat pumps?

Heat sources for geothermal energy production are naturally occurring, plentiful, and environmentally sustainable. These systems can replace the use of fossil fuels, which contribute to greenhouse gas production and global warming. Using geothermal energy can provide an alternative energy source for heating or cooling buildings. It can also be cost-effective if long-term operational costs are considered. Geothermal energy becomes more attractive as the cost of conventional energy sources increases – oil, electricity, propane, and natural gas.

## Are they safe for the environment?

Surface water heat pumps can be an environmentally safe alternate energy source if located, designed, installed, and operated properly.

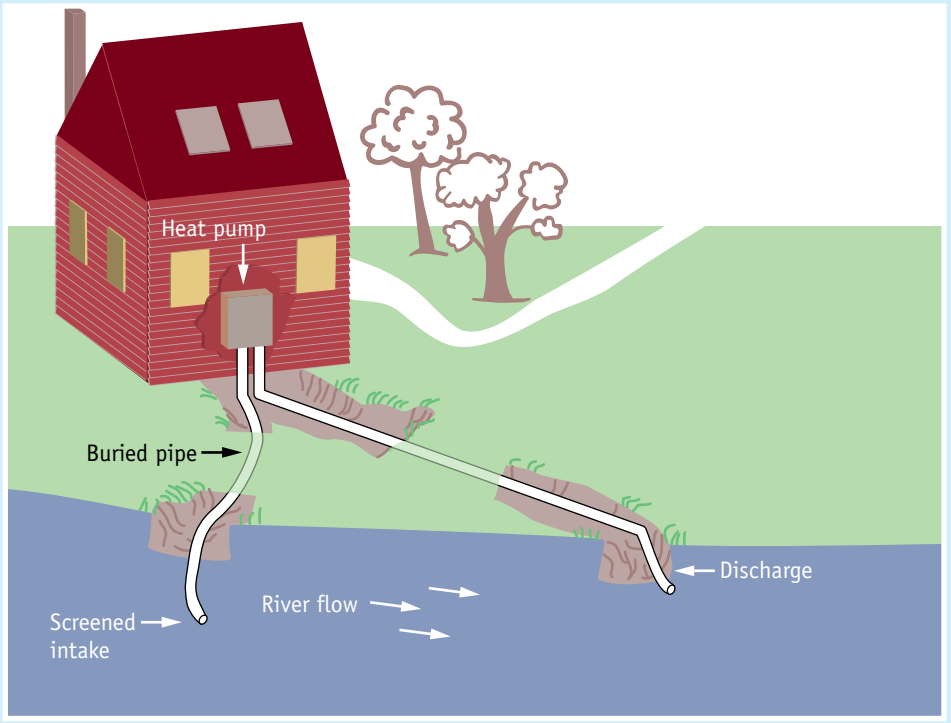
### Potential environmental concerns

**Lake mixing interference effects** – Open-loop systems can change natural currents and mixing in lakes. This can release nutrients and contaminants in bottom waters and thus affect water quality. For example, it may stir up nutrients that feed algae, a process called eutrophication.

**Surface water contamination** – Heat pumps may contaminate surface water either by accidentally releasing antifreeze fluids to surface waters or by pumping poor quality bottom waters to the surface.

Figure 2 • Example of an **Open-Loop** Surface Water Heat Pump System

*Diagram not to scale.*



**Temperature effects** – Heat pumps increase surface water temperatures in summer and decrease temperatures in winter. Cumulative effects of many small systems or large commercial or industrial systems can affect aquatic life habitat.

**Physical obstruction** – Piping in a watercourse can displace fish habitat and recreational water activities.

**Vulnerability to damag**e – Surface water installations can easily be damaged by human and natural forces such as ice, wind, and boating, thereby releasing fluids.

To avoid these potential environmental problems, surface water heat pumps should be located, designed, and installed by qualified and experienced contractors following the regulations and best management practices described below. Contractors should be CGC Accredited (Canadian Geo-Exchange™ Coalition Accreditation or similar).

## What regulations apply to surface water heat pumps in Nova Scotia?

Closed-loop systems and open-loop systems involve altering the watercourse bed and bank where the loop system enters the lake or pond. A Watercourse Alteration Approval is required for this activity in accordance with the Activities Designation Regulations.

Open-loop systems that withdraw more than 23,000 L/day from a watercourse must have a Water Withdrawal Approval in accordance with the Activities Designation Regulations. This applies to installations using flowing waters (rivers and streams). Withdrawals from lakes and ponds for this purpose are not recommended.

Wetlands are valued resources in Nova Scotia and are to be protected. You should avoid wetlands when considering heat pump installations. If this is not possible, you need an approval under the Activities Designation Regulations to alter any part of a wetland. Approval conditions require that you prevent the loss of wetland functions. Pre-consultation with the department is strongly recommended.

## What best management practices apply to surface water heat pumps in Nova Scotia?

The following best management practices are recommended for open-loop and closed-loop surface water heat pump systems in Nova Scotia:

- Design and install systems in accordance with the CSA standard for Design and Installation of Earth Energy Systems (CSA C448).
- Ensure that the technology is applied appropriately – avoid wetlands, sensitive fish habitat, drinking water supplies, and high-use recreational areas.
- Ensure that the system is designed and installed by a qualified and experienced contractor.
- Use open-loop systems only in dynamic, flowing waters, such as oceans and rivers to prevent water contamination.
- Use closed-loop systems in standing waters only, such as constructed ponds, to prevent water contamination and system damage.
- In closed-loop systems, use antifreeze solutions that meet the CSA standard, such as ethanol, propylene glycol, and methanol.

- Equip closed-loop systems with a pressure switch to prevent release of circulating fluids if the loop is damaged or breached.
- Monitor, maintain, and inspect in-watercourse components routinely to ensure the integrity of system components and anchoring system.
- Locate loop system near the building being heated and make sure that it does not interfere with neighboring properties or shoreline use and does not extend greatly into the watercourse.
- Post signs as navigation warnings.
- Ensure that all specific requirements of local authorities are followed, such as building codes.

## Where can I get further information?

- CSA standards can be obtained from the Canadian Standards Association at www.csa.ca.
- A Buyer's Guide for Residential Earth Energy Systems is available from Government of Canada Publications at publications.gc.ca/collections/Collection/M92-236-2001E.pdf.
- Canadian GeoExchange™ Coalition can be contacted through their website at www.geo-exchange.ca.
- Information on Ground Source Heat Pumps can be found here.

### Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Wastewater– Central Treatment

## QUICK FACTS

- Wastewater is used water from homes, businesses, and industries.
- Most homes in Nova Scotia are either connected to a municipal sewer system that leads to a treatment plant or have an on-site sewage disposal system.
- Wastewater may be treated in a number of ways, depending on where the treated wastewater is released into the environment and the size of the population.
- Wastewater treatment reduces the level of organic chemicals, nutrients, illness-causing germs, and suspended solids released into the environment.
- Many substances should never be disposed of in a drain, such as unused medicines, grease, and paints. They can disrupt the treatment process or end up in our lakes and rivers untreated.

**Wastewater or sewage is water that has been used for washing, flushing, or manufacturing processes** by homes, businesses, and industries. Wastewater is anything that goes down the drain – human waste, organic waste, and detergents.

## Wastewater Disposal

In many communities wastewater is collected through a network of underground pipes and delivered to a centrally operated treatment facility. The treated wastewater, or effluent, is then disinfected and discharged to the environment. About 55 per cent of homes in Nova Scotia dispose of their wastewater through central sewer collection.

The remaining 45 per cent of homes have individual home sewage disposal systems, mostly in rural areas. These are called septic systems or on-site sewage disposal systems. An on-site sewage system consists of a septic tank for settling and treatment, and a sub-surface disposal field that distributes the effluent. See our fact sheet *Wastewater – Septic Systems*, for more information.

## Central Collection

In many urban areas of Nova Scotia homes are directly connected to a municipal sewer system. Pipes connect your home to the central sewer system (*see Figure 1*) which transports the wastewater from each home to the wastewater treatment plant where it is treated to remove pollutants before it is released to the environment.

## Wastewater Treatment Levels

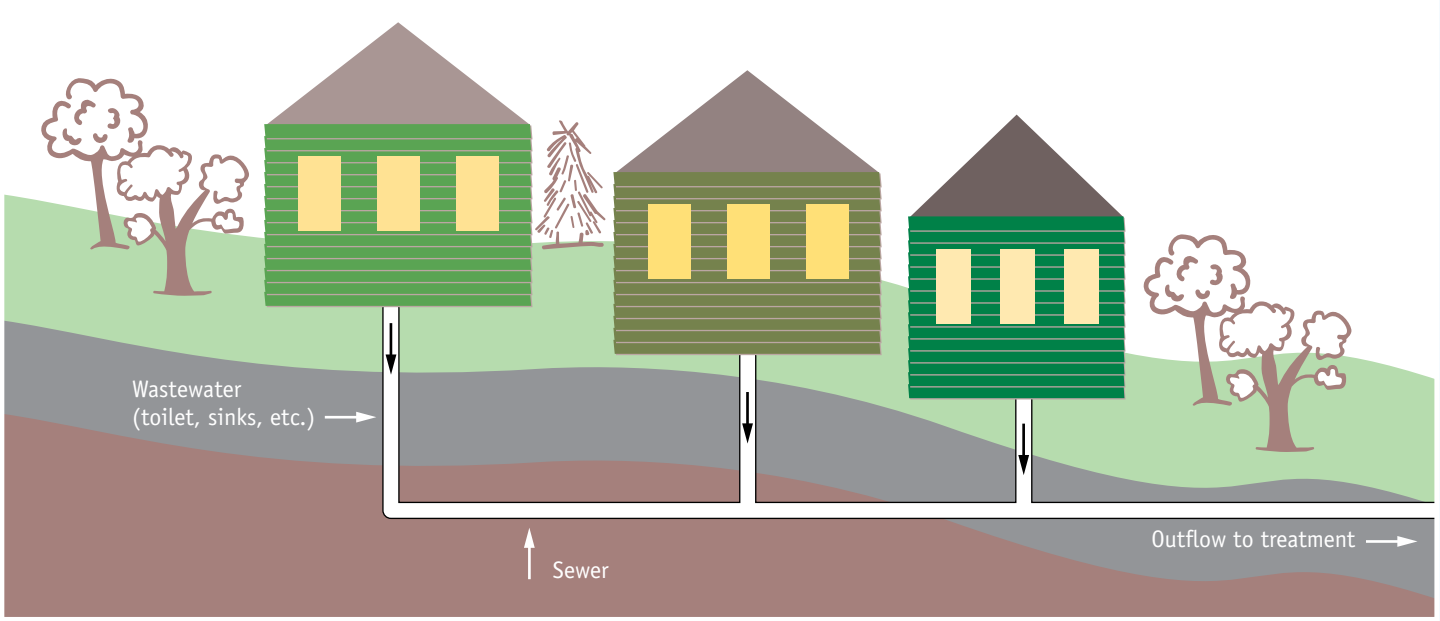
Wastewater treatment is usually a multi-stage process. The goal is to reduce or remove as much organic matter, solids, nutrients, disease-causing organisms, and other pollutants as possible from the effluent before it is discharged into the environment.

Wastewater may undergo up to three levels of treatment before it is discharged into the receiving body of water, or no treatment at all:

**0 raw wastewater**
**1 primary treatment**
**2 secondary treatment**
**3 tertiary treatment**

Figure 1 • Wastewater is Transported from Buildings to the Wastewater Treatment Plant

*Diagram not to scale.*




The receiving water body is typically a watercourse, such as a river, stream, lake, or ocean into which wastewater or treated effluent is discharged.

The level of treatment required depends on the

- salinity of the receiving water body – whether it is freshwater or saltwater
- existing quality of the receiving water body
- existing use of the receiving water body
- size of the treatment plant – that is, the amount of wastewater effluent being generated
- current federal, provincial, and municipal regulation

## Raw Wastewater

Raw wastewater is untreated wastewater. In the past, even once sewers became common, wastewater was often discharged without treatment directly into receiving water bodies. Water bodies have a certain natural ability to cleanse themselves, up to a point. Communities now realize the importance of maintaining good quality water for human and ecosystem health. Discharging raw wastewater into the environment is no longer considered appropriate. In most municipalities in Nova Scotia, wastewater is now treated before it is released.

## Primary Treatment

The first step in wastewater treatment involves separating large pieces of debris when the wastewater first enters the treatment plant. Debris may include wood, cloth, plastics, glass, metal, sand, and gravel. This is referred to as pre-treament.

The wastewater is held in a large sedimentation tank for several hours. This allows heavier sewage solids to settle to the bottom and form a sludge layer. Lighter solids, fats, oil, and grease float to the top creating a scum layer. The solids and scum are removed to receive further treatment as sludge. The clarified wastewater flows on to the next stage of wastewater treatment if there is to be further treatment of the effluent. If primary treatment is the only level of treatment, the clarified wastewater is disinfected and then discharged into the receiving water body.

In **Enhanced Primary Treatment** (also called **Advanced Primary Treatment**) chemicals are added to the sedimentation tanks to help waste particles bond together and settle out more readily. *Figure 2 shows a schematic diagram of the typical processes of primary wastewater treatment.*

## Secondary Treatment

Secondary treatment involves biological treatment of wastewater usually following the primary treatment stage. Some secondary treatment plants do not include the primary treatment process. Naturally-occurring bacteria break down the organic components of wastewater and additional settling occurs. These solids are either reused in the biological process or removed for further treatment and disposal. If secondary treatment is the final level of treatment, the clarified wastewater is disinfected and then discharged into the receiving water body. *Figure 3 shows a schematic diagram of the typical processes of secondary wastewater treatment.*

## Tertiary Treatment

Tertiary treatment of wastewater uses additional processes to further increase the quality of the wastewater effluent. These processes can be physical (filtration), biological, or chemical, based on the substances to be removed. This step further reduces the level of organic chemicals, nutrients, pathogens, and suspended solids in the treated effluent. Tertiary treatment is needed if wastewater must be treated to very high levels, such as when it is released into fresh water bodies. Figure 4 shows a schematic diagram of the typical processes of tertiary wastewater treatment.

Figure 2 • **Typical Primary** Treatment Process

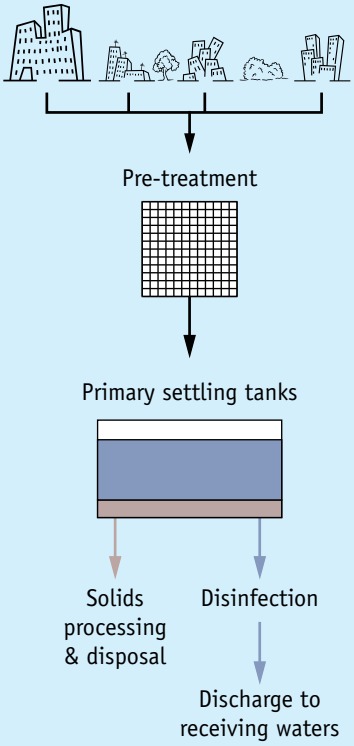



Figure 3 • **Typical Secondary** Treatment Process

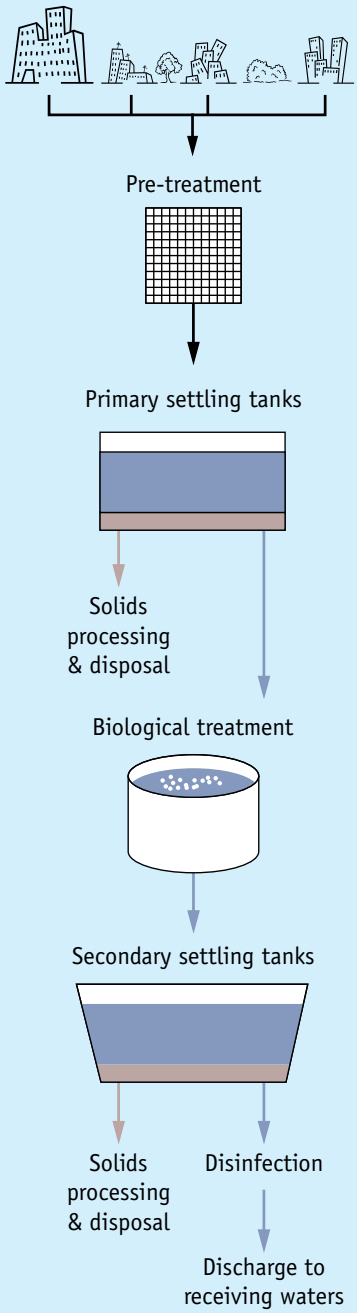
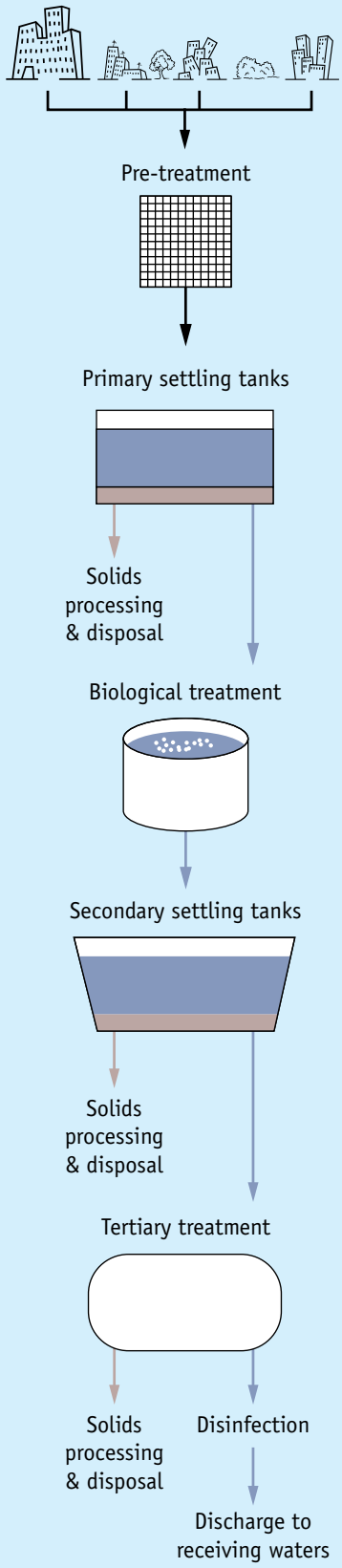



Figure 4 • **Typical Tertiary** Treatment Process



## Wastewater Management

The best way to limit the impacts of wastewater discharge is to reduce our water use. By practicing smart water usage and using water-efficient devices, such as low flow toilets, your household can drastically reduce the amount of water you consume, and in turn reduce the wastewater you generate. Additionally, some of the substances we flush down the drain cannot always be handled by the treatment system and can disrupt the treatment process. Because treatment systems are not designed to treat these substances, they may end up in our lakes, rivers, and oceans untreated.

**The following things should never be discharged down a drain:**

- **Unused household chemicals** – Purchase only as much as you need.
- **Unused pharmaceuticals, medications** – Return unused pharmaceuticals or medications to a pharmacy.
- **Fats, oils, and grease** – These can block your pipes and may result in expensive repairs. Dispose of these in your regular garbage or in your organics bin collection, if appropriate.
- **Paints, solvents, and vehicle fluids** – These are household hazardous wastes. Contact Divert NS for disposal information at www.rrfb.com or 1-877-313-RRFB (7732).

Municipal collection systems often have a sewer-use bylaw that governs the type of waste that can be discharged to a sewer system. Many municipalities are also developing pollution prevention programs to educate residents on the effects of discharging such substances into the sewer system.

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NOVA SCOTIA

# Wastewater– Septic Systems

**Wastewater is often referred to as sewage.** This is water that has been used for washing, flushing, or manufacturing processes by homes, businesses, and industries. Wastewater is made up of anything that goes down the drain, such as human waste, organic waste, and detergents.

## Wastewater Disposal

If you live in a rural community or if you have a cottage, you probably have an on-site sewage disposal system, also called a septic system. An on-site sewage system consists of a septic tank for settling and treatment as well as a sub-surface disposal field. About 45 per cent of homes in Nova Scotia have an on-site sewage disposal system.

The remaining 55 per cent of homes dispose of their wastewater through a central collection system. These systems collect wastewater through a network of underground pipes and deliver it to a central location for treatment before it is discharged to the environment. Treatment levels vary and can range from no treatment to very large systems. See our fact sheet *Wastewater – Central Treatment* for more information.

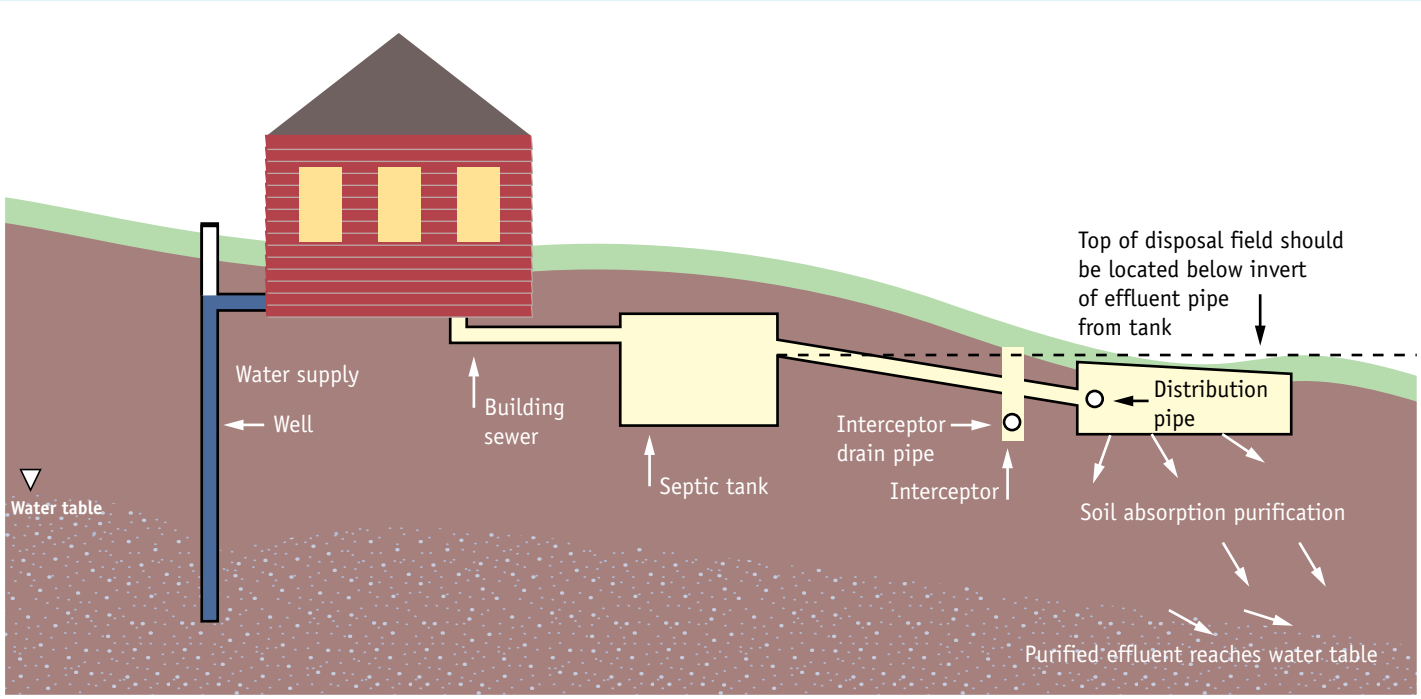
Some homes or cottages have composting toilets, holding tanks, or privies. In some cases, the sewage must be pumped out frequently and treated off-site.

## QUICK FACTS

- Wastewater is used water from homes, businesses, and industries.
- About 45 per cent of homes in Nova Scotia are connected to an on-site septic system for wastewater treatment and disposal.
- On-site septic systems reduce the amount of organic chemicals, nutrients, illness-causing germs, and suspended solids that are released into the environment.
- Septic tanks hold sewage long enough for solids to settle or float, and for bacteria to break down some of the solids naturally.
- The liquid waste is evenly distributed in a sub-surface disposal field.
- Septic tanks should be pumped out every 3 to 4 years.
- Other types of sewage systems, such as holding tanks and vault privies must be pumped out frequently and wastewater treated off-site.

Figure 1 • Components of a **Typical On-Site Sewage Disposal System**

*Diagram not to scale.*




## On-site Sewage Disposal Systems

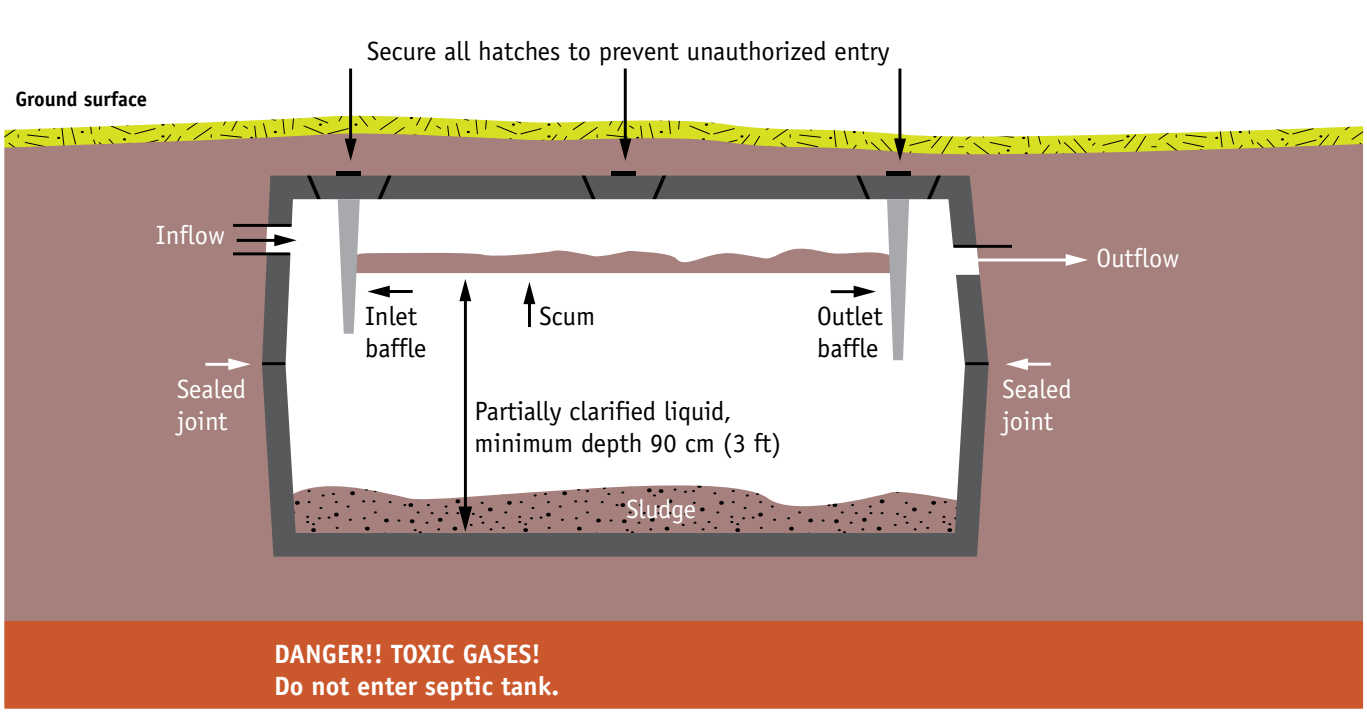
An on-site sewage disposal system uses natural processes to treat and dispose of the sewage or wastewater from buildings, such as private homes, where central wastewater collection is not available. A typical on-site system includes a septic tank and a disposal field that work together to treat the wastewater. Disposal fields are also called soil absorption areas or leach fields. *Figure 1 shows an example of an on-site system*.

When properly designed, installed, used, and maintained, on-site systems are economical, effective, reliable, and safe, and can last for many years. However, a system that is poorly designed, installed, used, or maintained could

- contaminate a water supply
- contaminate a watercourse, wetland, or marine water body
- harm human health
- cost a great deal to repair

Figure 2 • A Typical Septic Tank

*Diagram not to scale.*




## Septic Tank

Wastewater from the building normally flows by gravity through a building sewer pipe into the underground septic tank as shown in Figure 2. In some cases, wastewater is pumped from the building to the tank. Additional precautions may be necessary when pumping.

Tanks are made of corrosion-resistant materials, such as reinforced concrete, fiberglass, or polyethylene. Tanks must conform to Standard CAN/CSA-B66 or the latest version of this standard. The tank is watertight, with a watertight access cover. The access cover is secured as a safety precaution, but removable for maintenance, inspection, pumping of the tank, and effluent filter maintenance.

The septic tank (*see Figure 2)* holds the wastewater for about two days, although actual time depends on water use. This holding time allows the heavier sewage solids to settle and form a sludge layer on the bottom. The lighter solids, fats, greases, and oils float to the top and form a scum layer. The time that the wastewater is held in the tank also allows bacteria naturally found in the wastewater to break down the solids. The tank must be pumped regularly to remove the solids and scum that are not broken down by the bacteria. Otherwise both the sludge and the scum can foul the disposal field. How often you must have the tank pumped depends on the following factors:

- size of the tank
- number of people using the system
- percentage of the wastewater that is solid waste

An average family of four would need their tank pumped every 3 to 4 years.

An outlet in the tank allows the layer of partially clarified effluent to discharge into the disposal field for further treatment. Effluent is liquid waste, or water mixed with waste matter. This effluent still contains pathogens that can be dangerous to human and environmental health.

## Disposal Field

The disposal field consists of pipes made of perforated plastic that evenly distribute the effluent into the field. Effluent normally flows from the septic tank to a subsurface disposal field through watertight pipes by gravity because the water level in the tank is higher than the level in the field. Systems that cannot be gravity fed have pumps to carry the effluent from the tank to the disposal field.

As the effluent trickles from the pipes into the field, and eventually into the natural soil, microorganisms continue to treat the wastewater. Harmful pathogens are physically filtered out, naturally die off, or are destroyed by soil microorganisms.

Most or all of the effluent will eventually reach the groundwater table. Systems are designed to ensure that effluent is properly treated to remove harmful pathogens before they reach groundwater.

For this reason, it is important to have adequate separation distances from wells, cisterns, and other water bodies. Table 1 is a summary of minimum separation distances required for septic systems. Separation distances relate to the minimum distance between the septic system and its components from features on the lot or adjacent properties. Refer to the On-site Sewage Disposal Systems Regulations and the *On-Site Sewage Disposal Systems Standard* for more complete information.

**Table 1 • Minimum horizontal clearance distances as outlined in the On-site Sewage Disposal Systems Regulations and Guidelines**

| From | To | Distance (m) |
|---|---|---|
| System including disposal field, septic tank and pump or siphon chamber, holding tank or privy | Drilled well, with at least 6.1 m casing | 15 |
| | Dug well or any other domestic water supply | 30 |
| System including disposal field, holding tank or privy but excluding septic tank, pump, or siphon chamber | Cistern or any other contained water supply | 8.0 |
| | Surface watercourse, wetland, or marine water body | 30 |
| | Downslope ditch or drain that flows intermittently or any artificially created water body, other than an interceptor ditch | 15.0 |
| | Municipal or private water distribution system | 6.0 |
| | Foundation drainage system | 6.0 |

| | | |
|---|---|---|
| Septic tank, pump or siphon chamber and effluent pipe | Cistern or any other contained water supply | 5.0 |
| | Surface watercourse, wetland, or marine water body | 15 |
| | Wetland | 30.5 |
| | Municipal or private water distribution system | 3.0 |
| | Foundation drainage system | 1.5 |
| Disposal field | Well, located downslope (recommended) | 100.0 |

Disposal fields consist of several components, each with a different purpose. The main components are explained below:

**Perforated distribution pipe**
The perforated distribution pipe distributes the effluent evenly to all parts of the field through regularly spaced holes.

**Crushed rock**
Crushed rock surrounds and protects the pipe. It also stores and distributes the effluent over the disposal area.

**Filter sand**
Filter sand provides a place at the boundary between the sand and crushed rock for a biological clogging mat, which will form after a number of months of operation. The sand filters out harmful microorganisms and nutrients. This sand must meet specific permeability and size requirements.

**Geotextile**
A geotextile is a synthetic barrier material that prevents the backfill material from moving down into the crushed rock and clogging the openings between the rock particles.

**Sod**
Sod protects the disposal field against frost and erosion. This is especially important as rain can wash away the filter sand if it is not protected. Sod also stores surface water that soaks in until it evaporates or is used by plants.

**Clean local fill**
Clean local fill supports the sod by allowing oxygen and other gases to pass into and out of the disposal field. Imported sand fill may be used, if necessary, but it must meet specific permeability and size requirements.

**Natural soil**
Natural soil acts as the final filter to remove harmful organisms and absorbs nutrients before the effluent eventually reaches groundwater, which may flow to a lake or stream and may also supply a well with drinking water.

**Interceptor**
An interceptor can be a shallow trench at the ground surface, or it can be a trench filled with crushed rock containing a perforated pipe. Interceptor drains divert surface water and shallow groundwater away from the disposal field as shown in Figure 1. They help to prevent soil erosion and prevent the field from becoming water logged.

## Wastewater Management

On-site systems are built to handle certain types and amounts of wastewater. They can treat both blackwater (toilet wastes) and greywater (wastes from the kitchen sink, bath and showers, and laundry). Do not discharge water from other sources to the on-site system, because this extra water may overload the system. This includes water from roof drains, footing and foundation drains, basement sump pumps, heat pumps, and water treatment units.

**The following should never be discharged down a drain:**

- **Unused household chemicals** – purchase only as much as you need.
- **Unused pharmaceuticals and medications** – return unused pharmaceuticals or medications to a pharmacy.
- **Fats, oils, and grease** – these can block your pipes and may result in expensive repairs. Dispose of these in your regular garbage or in your organics bin collection, if appropriate.
- **Paints, solvents, and vehicle fluids** – These are household hazardous wastes. Contact Divert NS for disposal information at divertns.ca or 1-877-313-7732.

For more information, see our publication *Before You Construct an On-site Sewage System* at www.novascotia.ca/nse/water/docs/OnSiteSewageConstruction.pdf.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
1-877-9ENVIRO
or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Water Quantity

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

Water needs to be available in homes in the right quantity for everyday, seasonal, and special uses.

## Quantity

Homes of two to four people need 680 to 1360 litres (180 to 360 gallons) of water each day to meet typical water needs.

Typical household needs include

- Everyday use, such as drinking, cooking, and indoor plumbing, including toilets, bathtubs, showers, dishwashers, laundry, and water treatment units.
- Seasonal use, such as watering of lawns and gardens, car washing, backyard skating rinks, and swimming pools.
- Special uses, such as animal watering, crop irrigation, heat pumps, and backwashing of water treatment devices.

The water used in a day may be concentrated into one to two hours, often in different areas of the house at the same time. For the water supply to be able to meet peak demand, consider the following factors:

- flow rate, which is the continuous rate of yield for a well
- size of well, such as the depth and diameter
- static water level, which is the level at which the water stands in a well when no water is being pumped

## Water Shortages

Causes of water shortages include human activities, increased usage, problems in the plumbing system, and climatic conditions.

Most water shortages are the result of too little precipitation over an extended period of time, usually a season or more. To view information on province-wide groundwater levels, see our website at novascotia.ca/nse/groundwater/groundwaternetwork.asp.

During periods of water shortage, water levels in wells can decrease dramatically. Groundwater levels are usually higher during the spring, as a result of precipitation and snow melt, then gradually decline until early fall. Shallow dug wells are most vulnerable in dry weather conditions. In extreme cases, the water table could drop below the bottom of the well, resulting in a complete loss of water supply.

## Water Shortage Solutions

If it's the first time you have experienced a water shortage, check your pump and pressure system for mechanical or electrical problems. Call a qualified pump installer or electrician, if necessary. If possible, check the water level against a record of water levels kept for the well.

If you have experienced water shortages in the past, did they occur during dry conditions? If not, water shortages may indicate problems with the well, the pump system, or the aquifer the well taps into.

Consider the following changes to water use and to the pump, well, or storage in your water system to increase water availability:

### Conserve water

Reduce your overall water use indoors (kitchen, bathroom) and outdoors (garden, other uses) consistently all year round. Awareness and practice of water conservation will enable you to be more flexible during periods of water shortage. It will also reduce the amount of stress that is placed on your well and local water resources.

Water conservation is good practice, whatever the quantity available from the well. Using water-saving devices, such as reduced-flow shower heads, aerators, dual-flush toilets, and rain barrels will decrease your energy use and the load on your on-site septic or sewer system.

### Stagger water use

Run the shower, dishwasher, and washing machine at different times during the day. Spread laundry loads over more than one day, rather than all at once, if possible. This will increase the amount of water available for each of these activities individually.

### Adjust your pump

Lower your pump or pump intake deeper into the well. Before making any adjustments to the pump intake depth, it is essential to check your pump's specifications and consult a certified pump or well contractor to determine the maximum recommended depth setting for your pump and maximum recommended pumping rate for your well. Lowering the intake depth without a proper assessment could reduce the pumping rate and pump efficiency and make your problems worse. To search for a certified pump and well contractor visit: www.novascotia.ca/nse/cms/Search.asp.

### Change your pump

If your existing pumping equipment cannot achieve the recommended pumping rate, consider a larger pump. Make sure that the larger pump does not exceed the maximum safe pumping rate for your well. A pump that is too large could cause irreparable damage to your well. It is essential to consult a qualified pump or well contractor to determine your specific needs and the capacity of the well.

In some cases, installing a different type of pump may help. For example, a submersible pump instead of a jet pump, or a deep-well jet instead of shallow-well jet. This will be site-specific. It depends on well depth, diameter, static water level, yield, and stability of the borehole wall.

## Modify your well

Have a contractor deepen or modify the existing well. In some circumstances, having your existing well deepened can provide more water. Before making the decision to deepen your well, consult a qualified professional who will review water well records, hydrogeological information, and the geology of the immediate area. Factors such as proximity to salt water and the presence of poorer quality aquifers at depth must also be considered. This will help establish whether fresh water aquifers exist at depths below the depth of the well.

## Construct a new well

A new well could either replace or augment an existing well. If you had remedial work done on your well and continue to experience water shortage problems, consider constructing a new well. Before making the decision to construct a new well, consult a qualified professional to review water well records, hydrogeological information, and the geology of the immediate area. A local well driller or digger should also be familiar with local conditions. This review will provide you with essential information such as well depth, static water level, and well yield, and will help determine the best type of well (dug or drilled) for your needs. For more information, see our publication *Before You Construct a Water Well* at www.novascotia.ca/nse/water/privatewells.asp.

If the new well will replace the existing well, you must properly decommission the well that will no longer be used. See our fact sheet on well decommissioning for more information.

## Install more storage

Install a secondary water storage tank. The tank should be constructed of materials to meet the current NSF standards for potable water. NSF certification is an internationally recognized safety standard. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Test the water in the storage tank to make sure it is safe. Secondary storage often involves a tank to provide at least one day's water supply. This depends on the number of people in the house, water needs, and available space for installation. The secondary storage tank provides volumes of water during peak demands that the well would be unable to supply in the short term.

Consider the location of a secondary water storage tank – indoors, underground. Do you need to avoid freezing? If your water shortage or increased shortage needs are temporary and seasonal (summer), an above-ground water storage tank could provide short-term relief.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Well Decommissioning

**Decommissioning a well means to permanently fill in and seal it, eliminating it as a source of water.**

Improperly constructed, unused, or contaminated wells that are beyond repair must be properly decommissioned according to the Water Well Decommissioning Guidelines.

## Fill it and seal it

Wells no longer in use and not maintained must be properly decommissioned, otherwise unused wells may contaminate the aquifer.

Decommissioning a well

- ensures the safety of those in the vicinity of the well
- prevents surface water infiltration into an aquifer via the well
- prevents the vertical movement of water within a well
- conserves aquifer yield and hydraulic head
- removes physical hazards

## Use certified well contractors

Use contractors holding a valid certificate of qualification:

- for drilled wells – a certified well driller
- for dug wells – a certified well digger.

To search for a certified well contractor in Nova Scotia visit www.novascotia.ca/nse/cms/Search.asp.

## Steps to decommissioning a well

**1** Remove pumping equipment.

**2** Remove the casing or crocks.

**3a** For **drilled wells**, install the appropriate well grout material – neat cement, sand-concrete mix, bentonite grout, or bentonite chips.

**3b** For **dug well**, install clean natural backfill materials and for the upper 1 metre, install compacted clay or bentonite.

4 Mound earth at the site to eliminate surface water ponding.

**5** Establish vegetation for increased stability.

The procedure for decommissioning both drilled and dug wells is described in the Water Well Decommissioning Guidelines at www.novascotia.ca/nse/groundwater/docs/WellDecommissioningGuidelines.pdf.

Figure 1 • Diagram of the decommissioning of a typical **drilled well**

*Diagram not in scale.*

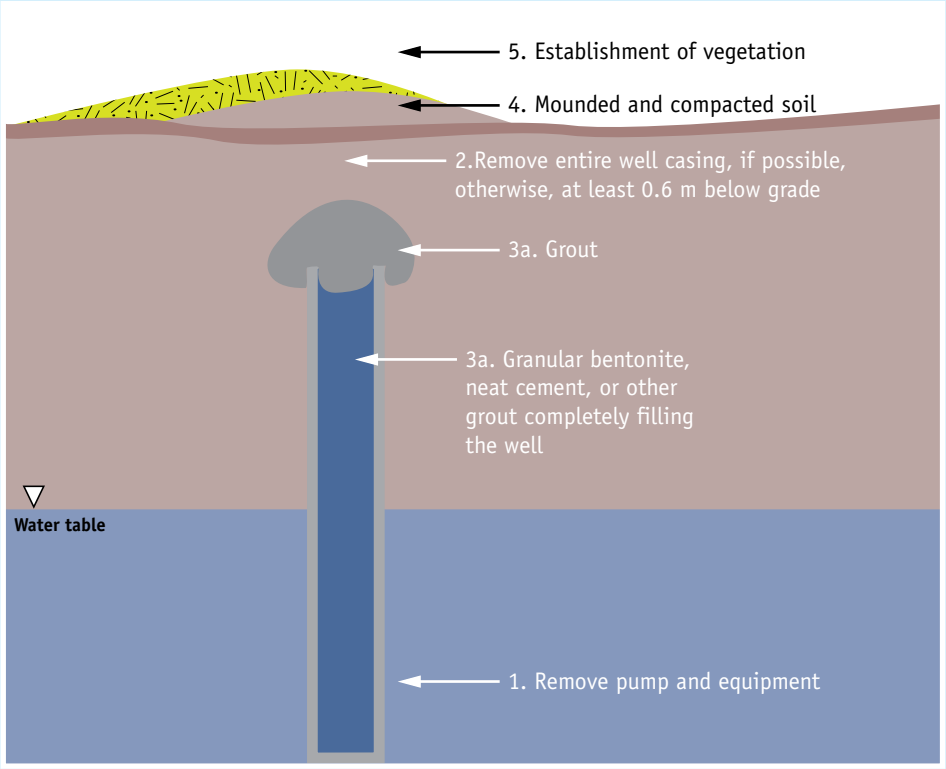
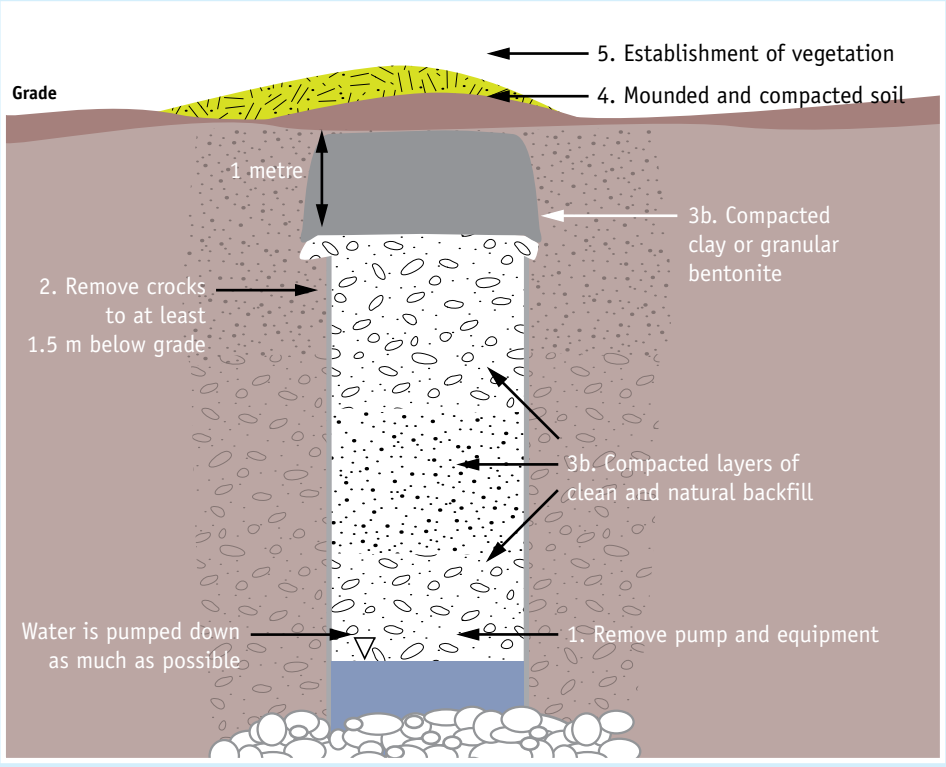



Figure 2 • Diagram of the decommissioning of a typical **dug well**

*Diagram not in scale.*



## Some wells need special care

Under some conditions, the well may need a site-specific decommissioning method or specialized grout material. The certified well contractor must submit alternative decommissioning methods to Nova Scotia Environment before proceeding.

Special decommissioning methods may be needed for wells that:

- have flowing artesian conditions
- are affected by salt water
- are high yield production wells
- are extremely deep
- have been contaminated by natural or man-made conditions
- have been constructed by neither drilling nor digging
- have other unusual conditions

## Cost

Homeowners bear the cost of well decommissioning. This can be expensive, but is both the duty and responsibility of the homeowner.

NOT decommissioning an unused well,

- is a safety hazard
- can threaten the integrity of the existing water supply
- can be more costly over time

## Duty to submit records

Decommissioning records must be submitted to Nova Scotia Environment.

## More than one well?

Sometimes more than one well may be present on a property. The previous owners may have had water shortages or other problems with their existing well. They may have replaced or added to the supply of wells.

If more than one well exists on the property, you should find out why. It may indicate previous

- water shortages
- well contamination
- improper construction of a well
- construction of a well for purposes other than drinking and regular household use

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Coliform Bacteria

***Maximum acceptable concentration for drinking water = NONE detectable per 100 mL***

**Total coliforms** are a group of bacteria commonly found in the environment, for example in soil or vegetation, as well as the intestines of mammals, including humans. Total coliform bacteria are not likely to cause illness, but their presence indicates that your water supply may be vulnerable to contamination by more harmful microorganisms.

## QUICK FACTS

- Total coliforms are a group of different kinds of bacteria.
- Coliform bacteria are found naturally in the environment and in the intestines of humans and animals.
- Escherichia coli (*E. coli*) is one member of the total coliform group of bacteria. It is naturally found only in the intestines of mammals, including humans.
- The main source of *E. coli* in drinking water is through recent contact with human or animal waste.
- The Canadian drinking water quality guideline for total coliform is **none detectable per 100 mL**.
- The Canadian drinking water quality guideline for Escherichia coli (*E. coli*) is **NONE detectable per 100 mL**.
- Coliform bacteria are used as a measure of the degree of pollution and the sanitary quality of well water.
- Coliform bacteria can be detected through laboratory testing. The lab reports the presence or absence of total coliform bacteria and Escherichia coli (*E. coli*).
- Do not assume that your water is safe to drink just because it has not made you sick in the past. If bacteria are present in your water, there is a risk that it could make you ill.
- If total coliform or E. coli are present in drinking water, consider well rehabilitation or replacement, or water treatment options.
- If bacteria are found in your water, it is not safe for drinking, preparing infant formula, preparing juices and ice cubes, washing fruits and vegetables, cooking, or brushing your teeth.

***Escherichia coli (E. coli)*** is the only member of the total coliform group of bacteria that is found only in the intestines of mammals, including humans. The presence of *E. coli* in water indicates recent fecal contamination and may indicate the possible presence of disease-causing pathogens, such as bacteria, viruses, and parasites. Although most strains of *E. coli* bacteria are harmless, certain strains, such as *E. coli O157:H7*, may cause illness.

## Sources

Total coliforms and *E. coli* are used as indicators to measure the degree of pollution and sanitary quality of well water, because testing for all known pathogens is a complicated and expensive process.

The main source of pathogens in drinking water is through recent contamination from human or animal waste, from

- improperly treated septic and sewage discharges
- leaching of animal manure
- stormwater runoff
- domestic animals or wildlife

During and after precipitation, bacteria and other harmful microorganisms from any of these sources may be washed into rivers, lakes, or groundwater. Poor well construction or poor maintenance can increase the risk of groundwater contamination.

## Acceptable Concentration

In water, coliform bacteria have no taste, smell, or colour. They can only be detected through a laboratory test.

The Canadian drinking water quality guideline for **total coliforms** is **none detectable per 100 mL**. The Canadian drinking water quality guideline for Escherichia coli (E. coli) is **none detectable per 100 mL**.

This means that in order to conform to the guideline:

- For every 100 mL of drinking water tested, no total coliforms or *E. coli* should be detected.

When drinking water is tested for total coliforms and *E. coli* and the water is safe to drink, the results may be presented in a variety of formats:

- absent
- 0 colony forming units per 100 millilitres (0 CFU/100 mL)
- less than 1 colony forming unit per 100 millilitres (< 1 CFU/100 mL)
- non-detect (ND)
- 0 most probable number per 100 millilitres (MPN/100 mL) – only when a bacteria count is requested

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

*E. coli* in drinking water indicates the water has been contaminated with fecal material that may contain disease-causing microorganisms, such as certain bacteria, viruses, or parasites.

The health effects of exposure to disease-causing bacteria, viruses, and parasites in drinking water are varied. The most common symptoms of waterborne illness include nausea, vomiting, and diarrhea. Infants, the elderly, and those with compromised immune systems may suffer more severe effects. In extreme cases some pathogens may infect the lungs, skin, eyes, nervous system, kidneys, or liver and the effects may be more severe, chronic, or even fatal.

You should not assume that your water is safe to drink just because it has not made you sick in the past. If bacteria are present in your water, there is a risk that it could make you ill.

## Testing

Regularly test your well water for a standard suite of bacterial and chemical parameters, including total coliforms and *E. coli*. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory. Take care when collecting the sample. See our website for basic procedures at www.novascotia.ca/nse/water/docs/MicrobiologicalSamplingProcedure.pdf. Samples must be kept cool and be delivered to the lab within 24 hours of sampling.

The cost of analyzing water samples can range from $20 for a single parameter to $250 for a full suite of bacterial and chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Test Results

If your test results found bacteria to be present, your water is not safe to drink. Retest your water to confirm the original results. Boil your water while you are waiting for your test results, or use another source for drinking, preparing infant formulas, preparing juices and ice cubes, washing fruits and vegetables, cooking, and brushing your teeth.

To destroy pathogens, bring water to a rolling boil for one minute. You do not usually need to boil water for other household purposes. Those who can avoid swallowing the water may shower, bathe, and wash using the well water. Toddlers and infants should be sponge bathed. Dishes and laundry may be washed in well water either by hand or machine.

If ***E. coli* is present** in the water, it means there has been recent fecal contamination and other pathogens may be present. Investigate the source of the bacteria and take corrective measures.

**If you boil water in a microwave**, include a glass rod or wooden or plastic stir stick in the container to provide sites for bubble formation. This prevents the formation of superheated water.

If ***E. coli* is absent,** but only **total coliforms are present**, it could mean one of three things:

- A layer of bacteria may have developed within your well or plumbing system. This layer of bacteria is called a biofilm.
- Surface water may be getting into your well. This increases the risk of animal waste contaminating your water sooner or later.
- Your well water may come from an aquifer that contains bacteria. This can happen when groundwater comes from a shallow source.

## Boiling Water

To kill microorganisms, you must keep water at a rolling boil for at least one minute. Water can be boiled either in a pot or kettle on a stove, in a microwave oven, or in an electric kettle without an automatic shut-off.

## Solutions

If *E. coli* is confirmed to be present in the well water:

- Inspect the well construction and repair or rehabilitate the existing well. Check separation distances between wells and sources of contamination. Determine if there is a source of *E. coli* near your well, such as a malfunctioning septic system. Table 1 shows the minimum distances that must be maintained according to the Nova Scotia Well Construction Regulations. For more information, see the Nova Scotia Well Construction Regulations at www.novascotia.ca/just/regulations/regs/envwellc.htm. Reconstruct the existing well, if necessary. In some cases it may be necessary to properly decommission the existing well and construct a new well. See our fact sheet on well decommissioning for more information.
- In the interim, use water that has been properly boiled, bottled water, or another source of water that has been tested and found to be safe for
  - drinking
  - preparing infant formula
  - preparing juices or ice cubes
  - washing fruits and vegetables
  - cooking
  - brushing your teeth
- Install a treatment system to treat your current source of water if there is no other source of water available and correction of the problem is not possible.

**Table 1 • Separation Distances Required by the Well Construction Regulations**

| Source of Potential Contamination | Type of Well | Minimum Distance from Well |
|---|---|---|
| cesspool (receiving raw sewage) | drilled well or dug well | 61 m |
| on-site sewage disposal system | drilled well | 15.2 m |
| | dug well | 30.5 m |
| sewer of tightly jointed pipe or equivalent material, sewer-connected foundation or floor drain, or water treatment discharge point | drilled well | 15.2 m |
| | dug well | 30.5 m |
| sewer with secondary containment, roof drainage discharge point, non-sewer-connected foundation or floor drain, or cistern | drilled well or dug well | 3 m |
| pumphouse floor drain | drilled well or dug well | 610 mm |
| above-ground petroleum storage tank system with a capacity of 1200 L or less | drilled well | 5 m |
| | dug well | 15.2 m |
| above-ground petroleum tank storage system with a capacity of greater than 1200 L | drilled well or dug well | 15.2 m |
| underground petroleum storage tank system | drilled well or dug well | 15.2 m |
| outer boundary of any public road or public highway | drilled well or dug well | 6.1 m |
| solid waste management facility, landfill, former dump site, or other significant source of potential contamination | drilled well or dug well | 61 m |

If ***E. coli* is absent**, but only **total coliforms are present**, solutions depend on why total coliforms are present:

- If a biofilm has developed within your well or plumbing system, you can disinfect your well and plumbing system.
- If surface water is getting into your well, you need to identify how surface water is entering your well and prevent this from happening. You may need the help of a well specialist.
- If your well water comes from an aquifer that contains bacteria, which can happen when groundwater comes from a shallow source, you have two options:
  - Drill a deeper well, which may solve the problem. Be sure to meet the separation distances outlined in Table 1 and properly decommission your old well.
  - Install a treatment system.

Compare the cost of drilling a new well to the long-term cost of buying and maintaining a treatment system. For more information on maintaining a safe drinking water supply, see the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Treatment

Bacteria cannot be removed from water with pitcher-type carbon filters. Bacteria can be removed by keeping water at a rolling boil for at least one minute.

Effective treatment methods for microbial contamination include

- permanent point-of-entry disinfection units, which can use
- chlorine
- ozone
- ultraviolet light (UV light)
- distillation

Buy a treatment system that has been certified to meet the current NSF standards for the inactivation of bacteria. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

An ultraviolet light unit purchased for the inactivation of pathogenic microorganisms must be certified to NSF Standard 55 Class A. Units without the Class A designation are only intended to be used for the reduction of non-pathogenic, nuisance organisms. Ultraviolet lights are intended for water that is visually clear (that is, not coloured, cloudy, or turbid). If the water is turbid, it should be filtered first to clarify the water.

Once installed, re-test your water to ensure that the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water. Testing should be conducted every three months for supplies that are contaminated with bacteria.

For more information on water treatment, see our publications *Fixing Bacterial Quality, Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Prevention

Tips for preventing bacteria, and other unwanted organisms, from entering a well:

- Make sure that the well casing is watertight and extends 152 millimeters (6 inches) or more above ground.
- Ensure the well has a proper vermin-proof cap.
- Disinfect the well, pump, and plumbing after repairs.
- Disinfect any water placed in a well for drilling, repair, or priming of pumps. Never use water from a lake or pond in your well.
- Keep pumps, well pipes, and well equipment off the ground when they are being repaired–laying them on the ground can cause them to become contaminated with bacteria.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Iron Bacteria and Sulphur Bacteria

**Iron bacteria and sulphur bacteria are small living organisms that naturally occur in soil, surface water, and groundwater.**

## Sources

Iron bacteria and sulphur bacteria are naturally occurring organisms in the environment.

**Iron bacteria** combine iron (or manganese), present in water, with oxygen. The iron bacteria may form large masses of an orangey-brown slime.

There are two categories of sulphur bacteria: sulphur oxidizers and sulphur reducers. **Sulphur-oxidizing bacteria** chemically change sulphide present in drinking water into sulphate. **Sulphur-reducing bacteria** live in oxygen-deficient environments. They break down sulphur compounds present in water, producing hydrogen sulphide gas in the process. Of the two types, sulphur-reducing bacteria are the more common.

Bacteria may be introduced during drilling or servicing of a well or when pumps are removed for repair and laid on the ground. Iron bacteria and sulphur bacteria can also exist naturally in groundwater. Iron bacteria are more common than sulphur bacteria, because iron is more abundant in groundwater.

## QUICK FACTS

- Iron bacteria or sulphur bacteria may be introduced during drilling, servicing, or repairing of a well, or may occur naturally in the groundwater.
- Iron bacteria and sulphur bacteria can coat the inside of the water system and create many water quality and quantity problems.
- Iron bacteria and sulphur bacteria can be detected through special laboratory testing.
- Iron bacteria and sulphur bacteria are not known to cause health problems in humans.
- Homeowners should use one of several treatment options to remove iron bacteria and sulphur bacteria from well water. Chemical treatments, especially with acids, should only be done by qualified professionals.
- In most cases, the bacterial populations will build-up again with time, and regular treatments may be required.
- Homeowners should take precautions to prevent iron bacteria and sulphur bacteria from entering a well.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Iron Bacteria and Sulphur Bacteria in Drinking Water

Iron and sulphur bacteria can create problems such as

- sudden, undesirable colour, stains or deposits
- stained plumbing fixtures and laundry
- unpleasant tastes and odours commonly reported as "swampy," "cucumber," "sewage," "rotten vegetation," or "musty," which may be more noticeable when the water has not been run for several hours
- reduced well yield and restricted water flow in distribution lines
- plugged water treatment equipment

The problems listed above are typical of iron bacteria or sulphur bacteria. However, objectionable stains, tastes, or odours may also be caused by iron, sulphate, hydrogen sulphide, or manganese.

## Iron Bacteria

Iron bacteria form rusty deposits, bacterial cells, and a slimy material that causes unpleasant smells and corrosion of plumbing materials. The sticky slime is typically rusty (reddish) in colour, but may be yellow, orange, brown, or grey. It can also appear as filament-like particles in the water or cause water to be a yellow, orange, or red colour. It can clog well screens, well casing, pipes, pumping equipment, and plumbing materials.

## Sulphur Bacteria

Sulphur-oxidizing bacteria produce effects similar to those of iron bacteria – a dark slime that can clog plumbing and well materials.

The most obvious sign of a sulphur-reducing bacteria problem is the distinctive "rotten egg" odour of hydrogen sulphide gas. See our fact sheet on hydrogen sulphide for more information.

## Health Risks

Iron bacteria and sulphur bacteria are not known to cause health problems or disease in humans.

## Testing

If you suspect iron or sulphur bacteria is present in your well water, contact an accredited water testing laboratory. A specific laboratory test is necessary to identify iron bacteria or sulphur bacteria in well water. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The special laboratory test for analyzing water samples for iron or sulphur bacteria can be relatively expensive and time consuming. The cost for each test can range from $60 to $100.

## Solutions

Iron bacteria and sulphur bacteria are often difficult to tell apart, because the symptoms are similar and often both types may be present. Fortunately, both types of bacteria can be treated using the same treatment techniques.

Eliminating iron or sulphur bacteria can be extremely difficult and only partially successful once they are established in the well. Treatment techniques used to remove or reduce iron or sulphur bacteria include physical removal, chemical treatment, and pasteurization.

Physical removal is typically done as a first step in heavily infected wells. The pumping equipment in the well must be removed and cleaned, normally by a qualified well contractor or pump installer. The well casing is then scrubbed. Physical removal is usually followed by chemical treatment.

## Treatment

Chemical treatment is the most commonly used method for removing iron bacteria or sulphur bacteria. Three groups of chemicals are most typically used:

- Disinfectants, such as chlorine, are the most commonly used chemical for treating iron or sulphur bacteria. Shock chlorination involves flushing the water system with large amounts of chlorine. It can be an effective way of controlling iron or sulphur bacteria, but may need to be repeated.
- Surfactants, which are detergent-like chemicals, are generally used in conjunction with other chemical treatment.
- Acids (and bases), which should only be handled by trained professionals.

Pasteurization has also been successfully used to control iron bacteria or sulphur bacteria. Steam or hot water is injected into the well and kept at 60°C for 30 minutes. Pasteurization is effective, but may be expensive.

The treatment methods listed above will likely solve the immediate aesthetic problems associated with iron or sulphur bacteria (odour, slime, etc.), but they may not be long-term solutions. Iron and sulphur bacteria may build up again a few months after treatment. However, both iron and sulphur bacteria are easier to control after the initial treatment.

The best treatment for both iron and sulphur bacteria is prevention.

Tips for preventing iron or sulphur bacteria from entering a well:

- Disinfect any water placed in a well for drilling, repair, or priming of pumps. Never use water from a lake or pond in your well.
- Make sure that the well casing is watertight, properly capped, and extends 152 millimeters (6 inches) or more above ground.
- Keep pumps, well pipes, and well equipment off the ground when they are being repaired – laying them on the ground can cause them to become contaminated with iron or sulphur bacteria.
- Disinfect the well, pump, and plumbing after repairs.

## Considerations

Be aware of the risk of bacteria entering your water system whenever work is done on its outside parts. Take the precautions listed above. Check your water system regularly and treat promptly.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Aluminum

***Maximum acceptable concentration for drinking water = 2.9 mg/L***

**Aluminum (Al)** is the second most abundant naturally occurring metallic element found in the earth's crust and is commonly present in rock minerals and dissolved in natural waters.

## Sources

Aluminum can occur naturally through the weathering of rocks and soils or because of human activities such as mining or other industrial manufacturing processes. In municipal drinking water sources, aluminum may be added to remove turbidity, organic matter, microorganisms, or other contaminants.

Although abundant in rocks and minerals, aluminum dissolves in natural waters most often in very low concentrations. However, waters with very low pH can show higher, more variable concentrations.

## Acceptable Concentration

The Guidelines for Canadian Drinking Water Quality has established a maximum acceptable concentration (MAC) of **2.9 milligrams per litre (mg/L)**.

Health Canada also advises an Operational Guideline (OG) of **0.100 mg/L**, for operational and aesthetic issues related to aluminum resulting from water treatment processes and typically applicable to municipal water distribution systems.

## QUICK FACTS

- Aluminum in drinking water has no taste, smell, or colour and can only be detected through chemical testing.
- The Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (MAC) for aluminum is **2.9 mg/L**.
- Exposure to high levels of aluminum in drinking water may affect your nervous system.
- Well water with aluminum greater than **2.9 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Short-term exposure (over days or weeks) to high levels of aluminum in drinking water can nausea, vomiting, diarrhea, ulcers, rashes, and arthritic pain.

Long-term exposure (over years or decades) to aluminum may affect your nervous system.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including aluminum. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

The cost for the bacterial and chemical contaminants tests vary depending on the laboratory and the contaminants you choose to test for.

Get the special sampling bottles and instructions on proper sampling from the laboratory.

## Solutions

If aluminum is present above 2.9 mg/L in the first test, get a second test to confirm the original result.

If aluminum is confirmed to be present above 2.9 mg/L in the well water, find an alternate source of water for drinking, cooking, and teeth brushing such as bottled water or another well that has been test and found to be safe.

## Treatment

Distillation or reverse osmosis technologies may be a potential solution for drinking water quantities under some conditions. However, specific applications of these technologies should be checked with a reputable water treatment contractor.

Aluminum cannot be removed from water through boiling. Boiling water may increase the concentration of aluminum.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Antimony

**Maximum acceptable concentration for drinking water = 0.006 mg/L**

**Antimony (Sb)** is a metal that is present naturally in small quantities in water, rocks, and soils.

## Sources

Antimony occurs naturally in the environment.

In groundwater, sources of antimony also include

- plumbing materials
- mining wastes
- manufacturing effluent
- leaching of fertilizers
- leaching of landfills
- fossil fuel combustion products

In water, antimony has no taste, smell, or colour. It can only be detected through a chemical test.

## Acceptable Concentration

The Canadian drinking water quality guideline for antimony is **0.006 milligrams per litre (mg/L)**.

## Health Risks

Short-term exposure (over days or weeks) to antimony in drinking water at very high concentrations (above 30 mg/L) can cause nausea, vomiting, and diarrhea.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with antimony levels greater than 0.006 mg/L may safely be used for bathing, handwashing, and dishwashing.

## QUICK FACTS

- Antimony is present in rock and soil.
- Antimony in drinking water has no taste, smell, or colour.
- Antimony can only be detected through chemical testing.
- The Canadian drinking water quality guideline for antimony is **0.006 mg/L**.
- Exposure to very high levels of antimony (above 30 mg/L) in drinking water can cause nausea, vomiting, and diarrhea.
- Well water with antimony greater than **0.006 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If antimony is present above **0.006 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including antimony. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If antimony is present above 0.006 mg/L in the first test, you must determine the source of the antimony. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the antimony is present in the groundwater or the plumbing materials.

If the source of antimony is corrosion of antimony-containing plumbing materials, consider the following options:

- Remove the source of antimony.
- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust pH so water is less corrosive (for more information, see our fact sheets on pH and corrosive water).
- Use a treatment system, to reduce antimony levels.
- Use alternative water sources, such as bottled water or another well that has been tested and found to be safe.

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for antimony reduction, effective treatment methods for reducing antimony levels in drinking water include

- coagulation/filtration
- distillation
- reverse osmosis

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Arsenic

***Maximum acceptable concentration for drinking water = 0.01 mg/L***

**Arsenic (As)** is a natural element found in the Earth's crust. Some areas of Nova Scotia have a greater potential for elevated arsenic levels in drinking water. *See Figure 1.*

## Sources

Arsenic is likely to be found in well water throughout Nova Scotia. The presence of arsenic in well water depends on the rock and soil type in the area.

The most common source of arsenic in groundwater is through erosion and weathering of soils, minerals, and ores. Industrial effluents and pesticide runoff may also contribute arsenic to water in some areas.

In water, arsenic has no taste, smell, or colour. It can only be detected through a chemical test.

## Acceptable Concentration

The Canadian drinking water quality guideline for arsenic is **0.01 milligrams per litre (mg/L)**.

The guideline limit for arsenic is based on the level that can be achieved by certified treatment units. Make every effort to keep arsenic levels as low as possible in drinking water.

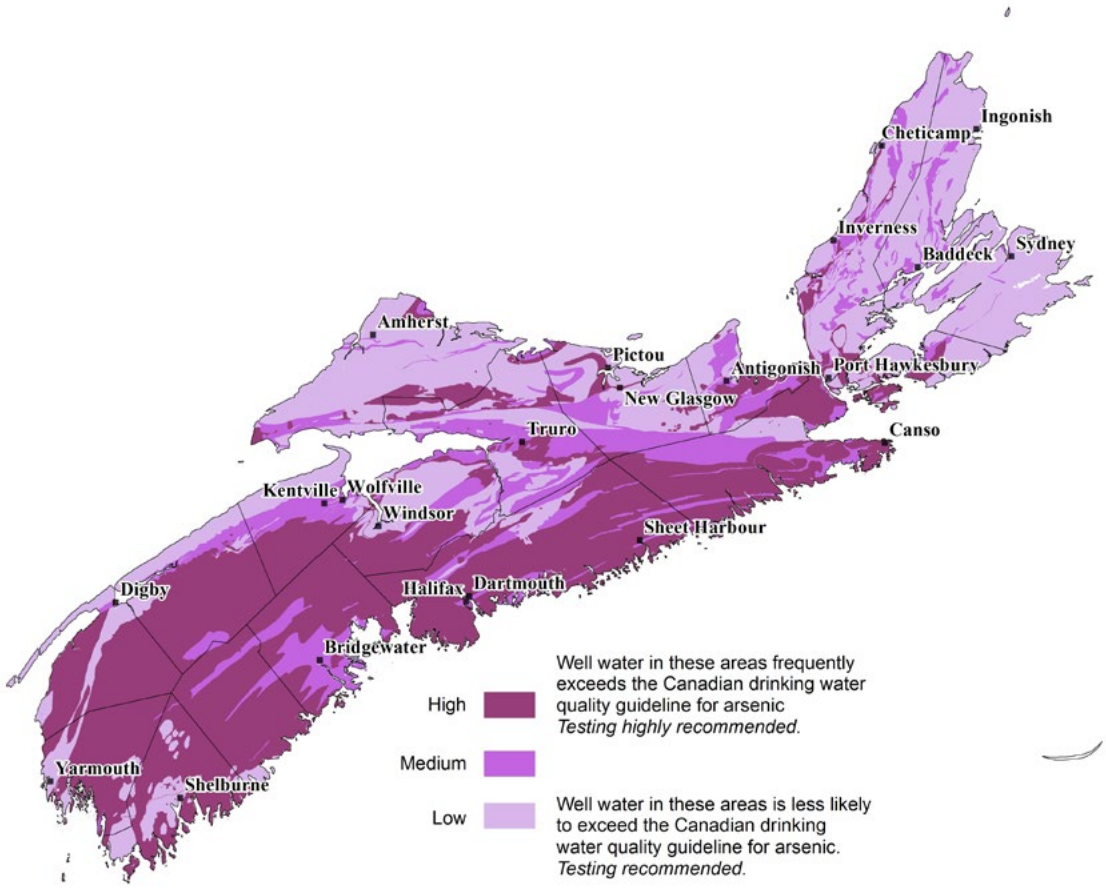
## Health Risks

Short-term exposure (over days or weeks) to high levels of arsenic in drinking water can result in nausea, diarrhea, and muscle pain.

## QUICK FACTS

- Arsenic is commonly found in well water throughout Nova Scotia.
- Arsenic in drinking water has no taste, smell, or colour.
- Arsenic can only be detected through chemical testing.
- The Canadian drinking water quality guideline for arsenic is **0.01 mg/L**.
- Exposure to high levels of arsenic in drinking water can cause nausea, diarrhea, and muscle pain. Over the long term, exposure to low levels of arsenic can cause certain types of cancer.
- Well water with arsenic greater than **0.01 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If arsenic is present in drinking water, consider water treatment options or alternative sources of water.

Figure 1 • Areas in Nova Scotia with naturally occurring arsenic in groundwater




Source:
https://novascotia.ca/natr/meb/data/pubs/17ofr03/ofr_me_2017-003.pdf

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

Long-term exposure (over years or decades) to low levels of arsenic in drinking water may cause certain types of cancer.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with arsenic levels greater than **0.01 mg/L** may safely be used for bathing, handwashing, dishwashing, and watering a garden.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including arsenic. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If arsenic is present in the first test, get a second test to confirm the original results.

If arsenic is confirmed to be present in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or a dug well that has been tested and found to be safe.

or

- Treat your current source of water to reduce arsenic levels.

## Treatment

Arsenic cannot be removed from water through boiling, chlorination, or pitcher-style filtration units. Boiling water may increase the concentration of arsenic.

Effective treatment methods include

- adsorption
- anion exchange
- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for arsenic reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

Drilled wells are more vulnerable to arsenic contamination than dug wells.

## Considerations for anion exchange method

Arsenic is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. If other more preferred anions are present such as uranium or sulphate, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently to reduce the concentration of arsenic to a satisfactory level. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect arsenic treatment.

If the anion exchange unit is not properly maintained, the arsenic contained on the resin bed may rapidly detach, leading to higher levels of arsenic in the treated water than the untreated water. It is important to follow instructions for resin regeneration and replacement.

Arsenic may be in a form that is not readily removed by anion exchange. When this is the case, pre-treatment by oxidation may be required.

**Drinking Water Interpretation Tool (DWIT)**

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Barium

***Maximum acceptable concentration for drinking water = 2.0 mg/L***

**Barium (Ba)** is a common element in the earth's crust, although only trace levels are normally found in natural waters.

## Sources

Barium is present as a trace element in both igneous and sedimentary rocks. It occurs most commonly as barite and witherite.

Barium compounds are often used in oil and gas well drilling operations. Industrial effluents may also contribute to barium in water in some areas.

## Acceptable Concentration

In water, barium has no taste, smell, or colour. It can only be detected through a chemical test.

The Guideline for Canadian Drinking Water Quality for barium is **2.0 milligrams per litre (mg/L)**.

## Health Risks

The amount of barium present in water is usually not high enough to become a health concern. However, there are some areas of Nova Scotia where barium may be elevated, primarily in areas underlain by sedimentary or carbonate rocks.

Exposure to very high concentrations of barium may cause gastrointestinal discomfort, muscular weakness, adverse effects to the kidneys, high blood pressure, and/or cardiovascular disease.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with barium levels greater than 2.0 mg/L may safely be used for bathing, handwashing, and dishwashing.

## QUICK FACTS

- Barium is present in rock and soil.
- Barium in drinking water has no taste, smell, or colour.
- Barium can only be detected through chemical testing.
- The Canadian drinking water quality guideline for barium is **2.0 mg/L**.
- Exposure to very high levels of barium in drinking water can cause gastrointestinal discomfort, muscular weakness, high blood pressure, and/or cardiovascular disease.
- Well water with barium greater than **2.0 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If barium is present above **2.0 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including barium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or look for "laboratories" In the Yellow Pages.

The cost for the bacterial and chemical contaminants tests vary depending on the laboratory and the contaminants you choose to test for.

Get the special sampling bottles and instructions on proper sampling from the laboratory.

## Solutions

If barium is present above 2.0 mg/L it is recommended that a second confirmatory test is completed.

If barium is confirmed to be present above 2.0 mg/L, consider the following actions:

- Inspect and properly maintain the well.
- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water.

or

- Treat your current source of water to reduce barium levels.

## Treatment

Barium cannot be removed from water through boiling. Boiling water may increase the concentration of Barium.

Effective treatment methods for barium include

- ion exchange
- reverse osmosis
- distillation

Reverse osmosis treatment systems should only be used at a point-of-use (i.e. the tap) because treated water may be corrosive to internal plumbing when installed at a point-of-entry.

Treatment systems that have been certified to meet the current NSF 53 or NSF 58 standards for barium reduction are recommended when available. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Filtration devices will lose their efficacy over time, therefore it is important to maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water. More frequent testing is also recommended to verify treatment performance.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Boron

***Maximum acceptable concentration for drinking water = 5 mg/L***

**Boron (B)** is a naturally occurring element found in rock and soil.

## Sources

Some boron found in groundwater is naturally occurring. The presence of boron in well water depends on the rock and soil type in the area.

Boron may also be present in groundwater due to

- coal combustion products
- municipal sewage
- leaching of landfill materials
- the production of fertilizers and pesticides

Some animal manure may also contain small amounts of boron.

## Acceptable Concentration

In water, boron has no taste, smell, or colour. It can only be detected through a chemical test.

The Canadian drinking water quality guideline for boron is **5 milligrams per litre (mg/L)**.

The guideline limit for boron is based on the level that can be achieved by treatment units. Make every effort to keep boron levels as low as possible in drinking water.

## QUICK FACTS

- Boron is present in rock and soil.
- Boron in drinking water has no taste, smell, or colour.
- Boron can only be detected through chemical testing.
- The Canadian drinking water quality guideline for boron is **5 mg/L**.
- Exposure to very high concentrations of boron in drinking water can cause reproductive and developmental abnormalities.
- Well water with boron greater than **5 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If boron is present above **5 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Health Risks

Some studies have shown that very high concentrations of boron in drinking water can cause reproductive malfunctions in men and developmental abnormalities. However, these occurred at much higher levels of boron than are commonly found in drinking water.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with boron levels greater than 5 mg/L may safely be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including boron. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If boron is present above 5 mg/L in the first test, get a second test to confirm the original results.

If boron is confirmed to be present above 5 mg/L in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or another well that has been tested and found to be safe.

or

- Treat your current source of water to reduce boron levels.

### Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for boron reduction, effective treatment methods for reducing boron levels in drinking water include

- adsorption
- distillation
- ion exchange
- reverse osmosis

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

Drilled wells may be more vulnerable to boron contamination than dug wells.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment
and Climate Change at
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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Cadmium

***Maximum acceptable concentration for drinking water = 0.007 mg/L***

**Cadmium (Cd)** is a naturally occurring element found in very low concentrations in most rocks, as well as in coal and petroleum. The main source of cadmium in drinking water however is through contact with plumbing materials with galvanized steel/iron.

## Sources

Cadmium can be present in groundwater through contact with dissolved rocks and minerals. The main source of cadmium in drinking water is through corrosion of plumbing materials with galvanized steel/iron components such as service lines, pipes, brass fittings, cement mortar linings and well components such as casings and drop pipes.

Other sources of cadmium in groundwater include:

- mining and smelting operations
- industrial operations
- burning of fossil fuels
- fertilizer application
- sewage sludge disposal
- leaching of landfills

## QUICK FACTS

- The main source of cadmium in drinking water is through corrosion of plumbing materials.
- Cadmium in drinking water has no taste, smell, or colour and can only be detected through chemical testing
- The Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (MAC) for Cadmium is **0.007 mg/L**.
- Exposure to high levels of cadmium in drinking water can cause gastrointestinal discomforts, kidney damage and reduced bone density.
- Well water with cadmium greater than **0.007 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If cadmium is present above **0.007 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Acceptable Concentration

The Guidelines for Canadian Drinking Water Quality has established a **maximum acceptable concentration (MAC) of 0.007 milligrams per litre (mg/L)**.

## Health Risks

Short-term exposure (over days or weeks) to high levels of cadmium in drinking water can cause nausea, vomiting, and diarrhea.

Long-term exposure (over years or decades) to cadmium in drinking water may cause kidney damage or reduced bone density.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including cadmium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

The cost for the bacterial and chemical contaminants tests vary depending on the laboratory and the contaminants you choose to test for.

Get the special sampling bottles and instructions on proper sampling from the laboratory.

## Solutions

If cadmium is present above **0.007 mg/L** in the first test, you must determine the source of the cadmium. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the cadmium is present in the groundwater or the plumbing materials.

If the source of cadmium is corrosion of cadmium-containing plumbing materials, consider the following options:

- Remove the source of cadmium.
- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust pH so water is less corrosive (see our fact sheets on pH and corrosive water for more information).
- Use a treatment system, to reduce cadmium levels.
- Use alternative water sources, such as bottled water or another well that has been tested and found to be safe.

## Treatment

Cadmium cannot be removed from water through boiling. Boiling water may increase the concentration of cadmium.

If the groundwater is found to have high levels of cadmium before entering the home, flushing the faucet will not be effective. Consider the following treatment systems to reduce cadmium levels:

- Adsorption filters using specific types of media for cadmium removal
- Distillation
- Reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for cadmium reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Calcium and Magnesium

**Calcium (Ca) and magnesium (Mg)** are both abundant in soil and rocks. They are both essential to human health.

## Sources

Calcium and magnesium are very common elements. Calcium is the fifth most abundant natural element, and magnesium the eighth. Both elements are present in all natural waters.

The most common source of calcium and magnesium in groundwater is through the erosion of rocks, such as limestone and dolomite, and minerals, such as calcite and magnesite.

## Aesthetic Objective for Drinking Water

No numerical Canadian drinking water quality guidelines exist for calcium or magnesium.

Calcium and magnesium are major contributors to water hardness. As contributors to hardness, calcium and magnesium can negatively affect drinking water quality. These effects are mainly aesthetic. See our fact sheet on hard water for more information.

## QUICK FACTS

- Calcium and magnesium are both abundant elements in water, soil, and rocks.
- Calcium and magnesium can be detected through chemical testing.
- No numerical guidelines for Canadian drinking water quality exist for calcium or magnesium.
- Calcium in drinking water may have some beneficial effects, but at very high levels can have some negative health effects.
- Magnesium in drinking water can have a laxative effect and can also affect the taste of water.
- Calcium and magnesium are major contributors to water hardness.
- If drinking water is excessively hard, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks: Calcium

Calcium may have beneficial effects when ingested. It may block the absorption of heavy metals in the body and is thought to increase bone mass and prevent certain types of cancer.

Very high concentrations of calcium may adversely affect the absorption of other essential minerals in the body.

## Health Risks: Magnesium

Magnesium may contribute undesirable tastes to drinking water. Sensitive people may find the taste unpleasant at 100 mg/L. The average person finds the taste unpleasant at about 500 mg/L. These levels are well above the magnesium concentrations found in most water.

Magnesium in drinking water may have a laxative effect, particularly with magnesium sulphate concentrations above 700 mg/L. However, the human body tends to adapt to this laxative effect with time.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including calcium, magnesium, and hardness. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

Calcium and magnesium are present in all water in Nova Scotia. If well water is found to be excessively hard (greater than 180 mg/L of $CaCO_3$), get a second test to confirm the original results.

Calcium and magnesium, the main contributors to hardness, are aesthetic parameters. Aesthetic parameters may impair the taste, smell, or colour of water. Although hardness does not pose a health risk at levels normally found in well water, it can affect the function and lifetime of the plumbing system and appliances.

Water hardness is measured by adding up the concentrations of calcium and magnesium and converting this value to an equivalent concentration of calcium carbonate ($CaCO_3$). The optimum range

of hardness in drinking water is from 80 to 100 mg/L. If excessive hardness is confirmed (greater than 180 mg/L of $CaCO_3$), treating your water is optional. You may choose to treat your water to

- improve the taste and make it more pleasing to consume
- increase the ability of soap to produce a lather
- decrease scale formation on well and plumbing materials and appliances

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

The most common treatment methods to reduce hardness, and therefore calcium and magnesium, in drinking water is ion exchange (water softener). Ion exchange works by pumping water through a tank containing a resin. This causes calcium and magnesium ions to be exchanged for sodium or potassium ions. This increases the concentration of sodium or potassium in the water. See our fact sheets on sodium and potassium for more information.

Another effective treatment method is reverse osmosis.

Once a system is installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

If water is softened by sodium or potassium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Chloride

**Chloride (Cl-)** is a negative ion of the element chlorine (Cl) and is widely distributed in the environment. It is present in water, soil, rock, and many foods.

## Sources

Chloride is found naturally in groundwater through the weathering and leaching of sedimentary rocks and soils and the dissolution of salt deposits. Chloride is often attached to sodium, in the form of sodium chloride (NaCl), which is used extensively for snow and ice removal.

Other sources of chloride in groundwater include

- saltwater intrusion and sea spray in coastal areas
- leachate from dumps or landfills
- water softener backwash
- sewage contamination
- leachate from abandoned, deep exploration holes or mines (rare)

## Aesthetic Objective for Drinking Water

**Aesthetic objective for drinking water ≤ 250 mg/L**

The Canadian drinking water quality guideline for chloride is an Aesthetic Objective (AO) of less than or equal to **250 milligrams per litre (mg/L)**.

Drinking water and drinks prepared with water containing chloride may have a

## QUICK FACTS

- Chloride is found naturally in groundwater through the weathering of rocks and soil.
- Human activities can also contribute to the presence of chloride in well water.
- In water, chloride has no smell or colour, but it can give water a salty taste.
- Chloride can be detected through chemical testing.
- The Canadian drinking water quality guideline for chloride is an Aesthetic Objective (AO) of less than or equal to **250 mg/L**.
- Chloride is often associated with sodium in drinking water, which may cause health concerns for people on sodium-restricted diets.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

salty taste at concentrations as low as 100 mg/L. Most people find that water with more than 250 mg/L of chloride is unpleasant to drink.

## Health Risks

Chloride itself in drinking water is generally not harmful to human beings.

At concentrations higher than 250 mg/L, the sodium associated with chloride may be a concern to people on sodium-restricted diets. See our fact sheet on sodium for more information.

Chloride may also contribute to the total dissolved solids (TDS) in drinking water. This may affect the rate of corrosion of steel and aluminum. Chloride may cause corrosion of some metals in pipes, pumps, fixtures, and hot water heaters. See our fact sheet on corrosive water for more information.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including chloride. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under “laboratories.”

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If chloride is present above 250 mg/L in the first test, get a second test to confirm the original results.

Chloride is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although chloride does not pose a health risk, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality, which may cause adverse health effects.

If chloride is confirmed to be present above 250 mg/L in the well water, investigate the source of chloride in drinking water. Consider the following options:

- If the chloride is from surface sources, such as sewage discharges, it may indicate the presence of pathogens or other contaminants present in surface water, which may cause adverse health effects.
- Test your well water for other contaminants, including bacteria.
- Inspect the well construction.
- Consider drilling a new well with proper site selection and construction to prevent contamination.
- If you use road salt on your property, handle, store, and use it properly to minimize groundwater contamination.
- Use water conservation measures, particularly in coastal areas, especially in summer months when groundwater recharge is lowest, to reduce the risk of saltwater intrusion.

When the source of chloride does not pose a health risk, treating your water is optional. You may choose to treat your water to improve the taste and make it more pleasing to consume.

When the source of chloride is from surface sources and other contaminants, including bacteria, are present, consider well construction improvements or water treatment options.

## Treatment

Chloride cannot be removed from water through boiling. Boiling may increase chloride concentrations.

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for chloride reduction, effective treatment methods for reducing chloride levels in drinking water include

- anion exchange
- distillation
- reverse osmosis

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

**Drinking Water Interpretation Tool (DWIT)**

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Chromium

***Maximum acceptable concentration for drinking water = 0.05 mg/L***

**Chromium (Cr)** is a metal found naturally in ores, soils, and plants.

## Sources

Chromium compounds from natural sources are usually found in groundwater in trace amounts only.

The most common man-made sources of chromium in groundwater are

- burning of fossil fuels
- mining effluent
- effluent from metallurgical, chemical, and other industrial operations

## Acceptable Concentration

Chromium may affect the taste or smell of well water, but not at levels normally found in groundwater.

The Canadian drinking water quality guideline for chromium is **0.05 milligrams per litre (mg/L)**.

## Health Risks

Chromium can be present in water in two forms, trivalent chromium (chromium 3) and hexavalent chromium (chromium 6).

Chromium 3 and chromium 6 have very different toxicity characteristics.

Chromium 3 is more commonly found in water. Chromium 3 is essential to human nutrition and is considered non-toxic. When chlorine is present, chromium 3 turns into chromium 6.

Exposure to chromium 6 at levels above 0.05 mg/L in drinking water may cause diarrhea, vomiting, abdominal pain, indigestion, convulsions, and liver and kidney damage.

## QUICK FACTS

- Chromium is present in rock and soil.
- Chromium in drinking water has no taste, smell, or colour.
- Chromium can only be detected through chemical testing.
- The Canadian drinking water quality guideline for chromium is **0.05 mg/L**.
- Chromium can be present as chromium 3 or chromium 6 in water.
- Exposure to high levels of chromium 6 in drinking water can cause kidney and liver damage
- Well water with chromium 6 greater than **0.05 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If chromium 6 is present above **0.05 mg/L** in drinking water, consider water treatment options or alternative sources of water.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with chromium levels greater than 0.05 mg/L may safely be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including chromium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If chromium is present above 0.05 mg/L in the first test, the laboratory can conduct a second test to determine if it is trivalent chromium (chromium 3) or hexavalent chromium (chromium 6).

If chromium 6 is confirmed to be present above 0.05 mg/L in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or another well that has been tested and found to be safe.

or

- Treat your current source of water to reduce chromium 6 levels.

## Treatment

Chromium cannot be removed from water through boiling.

Effective treatment methods include

- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for chromium reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Colour

**Ideally, drinking water should be clear and colourless**. A change in colour in drinking water may be the first indication of a water quality problem.

## Sources

Colour is normally more prevalent in surface water sources.

Groundwater is usually colourless. Colour in well water may indicate natural substances in the water supply, including

- dissolved organic matter such as humic substances, tannin, lignin, or coal
- inorganic materials such as iron, manganese, copper, or zinc

Colour in well water may also indicate inadequate water treatment or the presence of surface or subsurface contaminants in the water supply, including

- surface water containing dissolved organic matter
- suspended matter or industrial wastes, such as pulp and paper mill effluent or textile effluent

## QUICK FACTS

- Groundwater is naturally colourless. Colour in well water may mean dissolved organic or inorganic matter is present. This may be from natural causes or may indicate a water quality problem.
- Colour can be visually detected and confirmed through laboratory testing.
- The Canadian drinking water quality guideline for colour is an Aesthetic Objective (AO) of less than or equal to **15 TCU**.
- The presence of colour in drinking water may be indirectly linked to health, although its primary importance in drinking water is aesthetic.
- The source of the colour change must be investigated. The hue of the water may provide information regarding the source.
- The bacterial quality of the water and well construction should be checked.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Aesthetic Objective for Drinking Water

Aesthetic objective for drinking water
≤ 15 TCU

Relative colour intensity in water samples is measured using an arbitrary scale. The units are called true colour units (TCU).

The Canadian drinking water quality guideline for colour is an Aesthetic Objective (AO) of **less than or equal to 15 TCU**.

Most people can detect a colour of 15 TCU in a glass of water. In large volumes of water, such as in a bathtub, 5 TCU will be apparent. Few people can detect a colour level of 3 TCU.

## Colour in Drinking Water

The presence of colour in drinking water may be indirectly linked to health, although its primary importance in drinking water is aesthetic. Colour may be due to natural geology or may indicate possible drinking water contamination. The hue of the water may provide information regarding the source.

### Red-brown

Red, brown, or rusty coloured staining may indicate iron in well water. Adverse health effects are not expected at levels normally found in drinking water. See our fact sheet on iron and manganese for more information.

### Black

Brownish-black stains might be due to manganese in drinking water. Adverse health effects are not expected at levels normally found in drinking water. See our fact sheet on iron and manganese for more information.

### Yellow-brown

Humic substances, tannin, and lignin can impart a yellowish to brownish colour in water. Humic substances, tannin, and lignin are not believed to be harmful to human health. However, their presence in drinking water may mean other surface contaminants are also present. See our fact sheet on humic substances for more information.

### Green or blue

A green or blue colour is generally the result of water coming in contact with copper, often in the plumbing system. Very high concentrations of copper can cause nausea and other gastrointestinal discomforts. See our fact sheet on copper for more information.

### White

Water with a high concentration of zinc tends to have an opalescent (milky) appearance. Short-term exposure (over days or weeks) to very high levels of zinc can result in nausea and diarrhea. See our fact sheet on zinc for more information.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Testing

Regularly test your well water for a standard suite of chemical and physical parameters, including colour. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

Colour is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although colour does not pose a health risk, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality, which may cause adverse health effects.

If colour is confirmed to be present above 15 TCU in the well water, investigate the source of colour in drinking water. Consider the following options:

- If the colour is caused by surface sources, it may indicate the presence of pathogens or other contaminants present in surface water, which may cause adverse health effects:
- Test your well water for other contaminants, including bacteria.
- Inspect the well construction.
- Consider drilling a new well with proper site selection and construction to prevent contamination.

When the source of colour is naturally occurring and does not pose a health risk, treating your water is optional. You may choose to treat your water to improve the colour and make it more pleasing to consume.

When the source of colour is from surface sources and other contaminants, including bacteria, are present, consider well construction improvements or water treatment options.

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for colour adjustments, effective methods for treating colour in drinking water include

- coagulation
- distillation
- settling
- filtration techniques

Once a system is installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

The characteristics of iron, iron bacteria, and humic substances can be very similar in drinking water. It is important to determine which of these is causing water problems, because the treatment options are very different. Chlorine can be used to treat iron and iron bacteria, but chlorine added to water containing humic substances may contribute to the formation of trihalomethanes (THMs). For more information on THMs, see our fact sheet at www.novascotia.ca/nse/water/thm.asp.

Humic substances may interfere with the efficiency of certain other types of treatment units. Seek advice from a water treatment professional.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Copper

***Maximum acceptable concentration for drinking water = 2.0 mg/L***

**Copper (Cu) is found naturally in rock, soil, plants, animals, water, sediment, and air.** The main source of copper in drinking water is through contact with copper plumbing materials.

## Sources

Copper is frequently found naturally in groundwater, however, levels are generally very low. Common synthetic sources of copper include pesticide and mining processing waste.

Copper is often used in household plumbing materials, such as pipes and faucets. Corrosion of copper pipes is the greatest source of copper in drinking water. The amount of copper dissolved in drinking water depends on factors such as the pH, temperature, and alkalinity of water, as well as the length of piping and the amount of time water is left sitting in pipes.

## Acceptable Concentration

The Guidelines for Canadian Drinking Water Quality has established a **maximum acceptable concentration (MAC) of 2.0 milligrams per litre (mg/L) and an aesthetic objective (AO) of 1.0 mg/L**.

## QUICK FACTS

- Copper is naturally occurring, but most copper found in drinking water is from household plumbing materials.
- Very high concentrations of copper can cause nausea and other gastrointestinal discomforts.
- Copper in water can stain plumbing fixtures with a characteristic blue or green colour.
- The Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (MAC) for copper is **2.0 mg/L** and an Aesthetic Objective (AO) of **1.0 mg/L**.
- If copper is present above 2.0 mg/L in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

All living organisms, including humans, need copper to live. However, high concentrations of copper in drinking water can be harmful.

Immediate health effects from drinking water with copper above the guidelines limit include nausea, vomiting, diarrhea, and stomach cramps. Long-term exposure to very high levels of copper may lead to liver and kidney damage.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Copper levels greater than 2.0 mg/L may be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your water for a standard suite of chemical parameters, including copper. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or look for "laboratories" in the Yellow Pages.

The cost for the bacterial and chemical contaminants tests vary depending on the laboratory and the contaminants you choose to test for.

Get the special sampling bottles and instructions on proper sampling from the laboratory.

## Solutions

If copper is present above 2.0 mg/L in the first test, you should determine the source. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the copper is present in groundwater, well materials, or plumbing materials. While you are waiting for your test results, find an alternate source of water for drinking, cooking, and teeth brushing that has been tested and found to be safe.

If the source of copper is corrosion of plumbing materials, be aware that other metals, such as lead or cadmium, may also be released into the water. Get a metal scan done at an accredited water testing laboratory, because the presence of these other metals may also pose health risks.

If the source of copper is corrosion of copper in plumbing materials, consider the following options:

- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust the pH so water is less corrosive (for more information, see our factsheets on pH and corrosive water).
- Use a treatment system to reduce copper levels.
- Use alternative water sources, such as bottled water.

If the concentration is above the aesthetic objective, consider treatment to improve the aesthetic quality of the water.

## Treatment

Copper cannot be removed from water through boiling. Boiling water may increase the concentration of copper.

If the groundwater is found to have high levels of copper before entering the home, flushing the faucet will not be effective. Consider the following treatment systems to reduce copper levels:

- adsorption filters using carbon or specific types of resins (ion exchange)
- distillation
- reverse osmosis
- water pitchers

Buy a treatment system that has been certified to meet the current NSF 53 standards for copper reduction. Revers osmosis units should be certified to NSF 58 (which includes copper reduction). NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See their website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Filtration devices will lose their efficacy over time, therefore it is important to maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water. More frequent testing is also recommended to verify treatment performance.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the Your Well Water booklet series at https://www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
1-877-9ENVIRO
or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Corrosive Water

**Corrosive water** is water that reacts with and dissolves metal surfaces and materials.

## Sources

The rock and soil type that groundwater is in contact with determines how naturally corrosive the water is.

Corrosive water can also be a result of natural or artificial contamination by acid rock drainage where sulphide minerals are exposed to weathering processes.

The corrosive properties of the water are also related to other water quality factors, such as temperature, total dissolved mineral content, calcium hardness, alkalinity, and pH of the water.

Some treatment processes, such as ion exchange (water softeners) and reverse osmosis, can increase the corrosiveness of water.

## Health Risks

The primary health risk associated with corrosive water is through contact with metal plumbing materials. It may release metals present in plumbing materials, such as lead, cadmium, zinc, or copper, into drinking water.

## QUICK FACTS

- Corrosive water is water that reacts with and dissolves metal surfaces and materials.
- Corrosive water can be a result of natural or artificial processes.
- The primary health risk associated with corrosive water is that it may release metals present in plumbing materials, such as lead, cadmium, zinc, or copper, into drinking water.
- Metal plumbing materials are more likely to corrode if the water has a low pH or if the alkalinity is low.
- pH, alkalinity, lead, cadmium, zinc, and copper can be detected through laboratory testing.
- Exposure to lead or cadmium in drinking water can cause health risks. If lead or cadmium are present above the Canadian drinking water quality guideline in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

Metal plumbing materials are more likely to corrode if the water has a low pH (is very acidic) or if the alkalinity (the ability of the water to stabilize the pH) is too low. Figure 1 shows the relationship between pH and alkalinity and how they are factors in determining whether water is corrosive, scale-forming, or neutral.

The concentration of metals in drinking water will also increase as the water sits, or stagnates, in the pipes when the water is not used for several hours, such as overnight or during working hours.

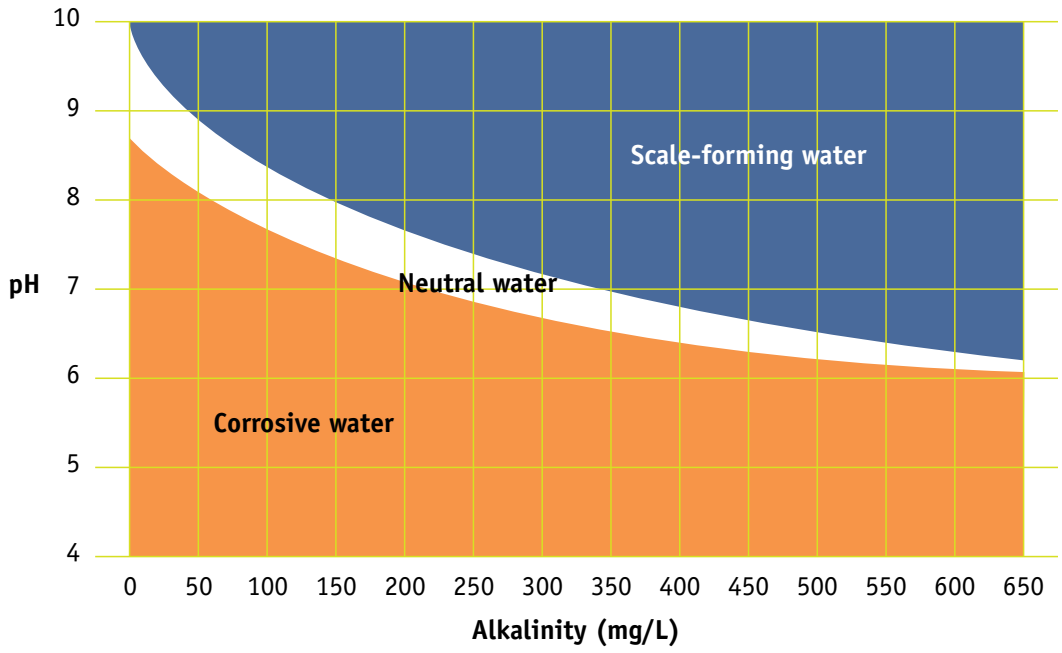
## Testing

Regularly test your well water for a standard suite of chemical and physical parameters, including pH, alkalinity, and a metal scan, including metals present in plumbing materials, such as lead, cadmium, zinc, and copper. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

Figure 1 • The relationship between pH, alkalinity, and water stability



## Solutions

If lead, cadmium, zinc, or copper are present above the Canadian drinking water quality guideline, you must determine the source of the metals. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the metals are present in the groundwater or the plumbing materials.

Lead and cadmium both pose health risks. Lead has acute health effects and affects children, infants, and unborn children more strongly, because their bodies absorb lead more readily that adults. If lead is present in your well water above the guideline limit, find an alternate source of water for drinking, cooking, and teeth brushing that has been tested and found to be safe, while you are waiting for your second lead test results. See our fact sheets on lead and cadmium for more information.

Zinc and copper are aesthetic parameters. Aesthetic parameters may impair the taste, smell, or colour of water. Zinc and copper do not pose serious health risks. See our fact sheets on zinc and copper for more information.

If the source of lead, cadmium, copper, or zinc is corrosion of plumbing materials, consider the following options:

- Remove the source.
- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust pH so water is less corrosive (for more information, see our fact sheet on pH).
- Use a treatment system to reduce lead, cadmium, zinc, or copper levels.
- Use alternative water sources, such as bottled water or another well that has been tested and found to be safe.

## Treatment

Buy a treatment system that has been certified to meet the current NSF standards for the reduction of the specific metal. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Fluoride

***Maximum acceptable concentration for drinking water = 1.5 mg/L***

**Fluoride (F-)** is a negative ion of the element fluorine (F), which can be found in various chemical compounds. It is present in air, water, soil, and most foods.

## Sources

Fluoride is a naturally occurring chemical found within many rock types. Fluoride in groundwater is often associated with weathering processes, primarily in areas underlain by shales, sandstones, and some fractured zones of granite bedrock, but not only in these areas.

Common synthetic sources of fluoride include

- the manufacture of phosphate fertilizers
- runoff from agricultural areas using chemical fertilizers
- septic and sewage treatment system discharges from areas with fluoridated water

Fluoride is added to many municipal drinking water supplies and dental products, such as toothpastes and mouthwashes, to help prevent tooth decay.

## QUICK FACTS

- Fluoride is likely to be present in groundwater in areas underlain by shales, sandstones, and some granite bedrock.
- Fluoride in drinking water has no taste, smell, or colour.
- Fluoride can only be detected through chemical testing.
- The Canadian drinking water quality guideline for fluoride is **1.5 mg/L**.
- Exposure to excess fluoride in drinking water can cause dental fluorosis. Over the long term, it can cause skeletal fluorosis.
- Well water with fluoride levels greater than **1.5 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If fluoride is present above **1.5 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Acceptable Concentration

In water, fluoride has no taste, smell, or colour. It can only be detected through a chemical test.

The Canadian drinking water quality guideline for fluoride is **1.5 milligrams per litre (mg/L)**.

## Health Risks

Exposure to low concentrations of fluoride, such as those added to municipal water supplies (0.8 – 1.0 mg/L), can reduce the risk of dental cavities.

Exposure to fluoride concentrations greater than 1.5 mg/L when teeth are developing (up to age 6 or 7) can cause dental fluorosis, which can cause discolouration of teeth, white spots, and pitting or mottling of tooth enamel. Exposure to extreme concentrations of naturally occurring fluoride over a long period of time can result in skeletal fluorosis, which can cause chronic joint pain, restriction of mobility, and increased risk of bone fractures.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with fluoride levels greater than 1.5 mg/L may be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including fluoride. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under “laboratories.”

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If fluoride is present above 1.5 mg/L in the first test, get a second test to confirm the original results.

If fluoride is confirmed to be present above 1.5 mg/L in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or another well that has been tested and found to be safe.

or

- Treat your current source of water to reduce fluoride levels.

## Treatment

Fluoride cannot be removed from water through boiling, chlorination, or pitcher-style filtration units.

Effective treatment methods include

- anion exchange, if other anions are not present
- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for fluoride reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations for anion exchange method

Fluoride is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. If other more preferred anions are present such as uranium, sulphate, arsenic, nitrate, or nitrite, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently to reduce the concentration of fluoride to a satisfactory level. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect fluoride treatment.

Anion exchange may not be the best choice to remove fluoride if other more preferred anions are present.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Humic Substances

**Humic substances** are the end product of decaying organic matter.

Tannin and lignin are organic compounds similar to humic substances. Tannin is a complex organic compound found naturally in soil and in certain tree barks. Lignin is a natural compound common in woody plants and trees.

## Source

Humic substances come from the accumulation and natural chemical reaction of by-products produced by the biodegradation of organic matter. They are commonly present in soils, surface water, sewage, compost heaps, marine and lake sediments, peat bogs, carbonaceous shales, and lignites.

There are three types of humic substances, which differ slightly in acidity and chemical composition. They are humic acid, fulvic acid, and humin.

Tannin is abundant in the bark, fruit, and leaves of plant material. Lignin is one of the principal constituents of the woody structure of seed plants. Tannin and lignin are part of a natural group of organic substances in soil, produced by decaying vegetation.

## QUICK FACTS

- Humic substances are the end product of decaying organic matter.
- Tannin and lignin are natural organic substances found in plants and soil.
- Humic substances, tannin, and lignin may be present in well water that is hydraulically connected to surface water, but may also be found in certain bedrock types, such as those containing coal.
- No numerical Canadian drinking water quality guidelines exist for humic substances, tannin, or lignin. Their presence may sometimes be inferred from measurement of colour and dissolved organic carbon.
- Humic substances, tannin, and lignin may affect the taste, colour, or smell of drinking water.
- The presence of humic substances, tannin, or lignin in well water may indicate a natural benign source or the presence of other contaminants in the water.
- Several treatment options can reduce the concentration of humic substances, tannin, and lignin in drinking water.

The main source of humic substances, tannin, and lignin is natural organic material. They may also be present in groundwater due to

- the proximity to areas underlain by coal
- the dissolution of bark mulch
- buried organic debris such as tree stumps
- the wastewaters of leather and wood-working industries (tannin and lignin)
- pulp and paper mill effluent (lignin)

Humic substances, tannin, and lignin are most common in surface water and shallow groundwater hydraulically connected to surface waters or wetlands. These organic substances may occasionally be found in well water, particularly if the well is not properly constructed.

## Maximum Acceptable Concentration for Drinking Water

No numerical Canadian drinking water quality guidelines exist for tannin, lignin, or humic substances. However, the presence of humic substances is addressed in Health Canada's drinking water quality guideline on colour.

## Humic Substances in Drinking Water

Humic substances are not believed to be harmful to human health. At higher concentrations, humic substances can impart a characteristic yellowish to brownish colour in water, and can cause drinking water to have a bitter taste or unpleasant odour. The odour is not from the humic substances themselves. Humic acid may stimulate the growth of aquatic micro-organisms, some of which may produce an odour.

The presence of humic substances in drinking water may be due to natural organic sources, but may also indicate contamination from surface water sources. The presence of pathogens or other contaminants present in surface water may cause adverse health effects.

Humic substances can adsorb a variety of organic substances. Many metals present in drinking water can also react with humic substances in water, which can increase the concentration of metals in the water.

## Tannin and Lignin in Drinking Water

Tannin and lignin can impart a yellow or light brown colour, bitter taste, and unpleasant odour in drinking water. The presence of tannin or lignin in drinking water may be from benign natural sources, but could be cause for concern if contaminants present in surface water are also present in well water.

## Testing

If you suspect tannin or lignin is present in your well water, contact an accredited water testing laboratory. A specific laboratory test is necessary to identify tannin or lignin in well water. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The special laboratory test for analyzing water samples for tannin or lignin can cost between $60 and $100.

Currently, no laboratories in Nova Scotia provide analysis for humic substances. However, the test results for tannin and lignin, as well as colour and dissolved organic carbon, may provide some information about the presence of humic substances in your well water. See our fact sheet on colour for more information.

## Solutions

If humic substances, tannin, or lignin are suspected or found to be present in well water, it may be due to natural conditions, or may mean that the groundwater in the well is under the direct influence of surface water. To determine whether humic substances, tannin, or lignin are naturally present in the groundwater or if microbial pathogens are able to travel from nearby surface water to the groundwater source, you should

- have a water quality professional investigate the source of the contamination
- check the bacterial quality of the water
- inspect the well construction

If bacterial quality and well construction are acceptable, and there is no evidence of other contamination, treating your water is optional. You may wish to

- Obtain drinking water from an alternate source, such as bottled water or a nearby well that has been tested and found to be safe.
- Install a treatment system to improve the appearance of your water.

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for the reduction of humic substances, tannin, or lignin, effective treatment methods for reducing their levels in drinking water include

- activated carbon
- anion exchange
- chlorination/filtration

The best treatment option may depend on the source of the humic substance, tannin, or lignin.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Considerations

The characteristics of iron, iron bacteria, and humic substances can be very similar in drinking water. It is important to determine which of these is causing water problems, because the treatment options are very different. Chlorine can be used to treat iron and iron bacteria, but chlorine added to water containing humic substances may contribute to the formation of trihalomethanes (THMs). For more information on THMs, see our fact sheet at www.novascotia.ca/nse/water/thm.asp.

Eliminating humic substances, tannin, and lignin is extremely difficult, especially at higher concentrations.

The presence of humic substances, tannin, and lignin may also affect the efficiency of several other types of treatment units for other parameters.

### Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Hard Water

**Hard water is water with a high mineral content.** Water is made hard by high levels of metal ions, mainly calcium (Ca2+) and magnesium (Mg2+) in the form of carbonates.

## Sources

Water hardness in most groundwater is naturally occurring from weathering of sedimentary rock and calcium-bearing minerals, such as calcite, limestone, dolomite, or gypsum.

Hard water can also occur locally in groundwater from chemical and mining industry effluent or excessive use of lime in agriculture.

## Aesthetic Objective for Drinking Water

Water hardness is measured by adding up the concentrations of calcium and magnesium, and converting this value to an equivalent concentration of calcium carbonate ($CaCO_3$).

## QUICK FACTS

- Hard water is caused by the presence of minerals such as calcium and magnesium.
- Human activities may also contribute to hardness of groundwater in certain areas.
- Hardness in the form of equivalent $CaCO_3$ concentration can be detected through chemical testing.
- No numerical guidelines for hardness exist, but the Guidelines for Canadian Drinking Water Quality divide hardness into four categories – soft, medium, hard, and very hard – based on equivalent $CaCO_3$ concentrations.
- Hard water is not considered a health risk at equivalent $CaCO_3$ concentrations normally found in Nova Scotia.
- Treatment systems are available to reduce water hardness.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

No numerical guideline for hardness exists, but the Guidelines for Canadian Drinking Water Quality divide hardness into four categories:

**Soft** – less than 60 milligrams per litre (mg/L) of equivalent $CaCO_3$

**Medium** – 60 mg/L to 120 mg/L of equivalent $CaCO_3$

**Hard** – 120 to 180 mg/L of equivalent $CaCO_3$

**Very hard** – greater than 180 mg/L of equivalent $CaCO_3$

The optimum range of hardness in drinking water is from 80 to 100 mg/L. Water with hardness greater than 200 mg/L is considered poor, but can be tolerated. Water with hardness greater than 500 mg/L is normally considered unacceptable for domestic purposes.

## Health Risks

Hard water is not a health risk. It is mainly an aesthetic concern, because of the taste that a high concentration of calcium and other ions give to water.

Hard water also reduces the ability of soap to produce a lather and causes scale formation in pipes, on plumbing fixtures, and in heating systems.

In agricultural areas where lime and fertilizers are applied to the land, excessive hardness may indicate the presence of other chemicals such as nitrate.

In very rare cases where $CaCO_3$ concentrations in drinking water are greater than 1000 mg/L, hard water has been associated with an increased incidence of gallstones and kidney stones.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including hardness. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If well water is found to be excessively hard (greater than 180 mg/L of $CaCO_3$), get a second test to confirm the original results.

Hardness is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although hardness does not pose a health risk at levels normally found in well water, it can affect the function and lifetime of the plumbing system and appliances.

If excessive hardness is confirmed (greater than 180 mg/L of $CaCO_3$), treating your water is optional. You may choose to treat your water to

- improve the taste and make it more pleasing to consume
- increase the ability of soap to produce a lather
- decrease scale formation on well and plumbing materials as well as appliances

## Treatment

The most common treatment method to reduce hardness in drinking water is ion exchange (water softener). Ion exchange works by pumping water through a tank containing a resin. This causes calcium and magnesium ions to be exchanged for sodium or potassium ions. This increases the concentration of sodium or potassium in the water.

Another effective treatment method is reverse osmosis.

Buy a treatment system that has been certified to meet the current NSF standards for hardness reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations for ion exchange (water softener) method

An increase in sodium concentration may be a concern to those on sodium-reduced diets. See our fact sheet on sodium for more information.

An increase in potassium may cause adverse health effects to those with kidney dysfunction or those taking medications that interfere with normal potassium-dependent functions in the body. See our fact sheet on potassium for more information.

The Guidelines for Canadian Drinking Water Quality recommend that if you use ion exchange (water softener) for treatment, keep a separate, non-softened water supply for drinking and cooking.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Hydrogen Sulphide

**Hydrogen Sulphide ($H_2S$)** is a dissolved gas that gives water a characteristic rotten egg taste and odour.

## Sources

Hydrogen sulphide gas can occur naturally in groundwater. It may be produced from the decomposition of organic matter underground, such as decaying plant material, or by chemical reduction of sulphate by sulphate-reducing bacteria.

Hydrogen sulphide can be found in deep or shallow wells. It is often present in areas

- underlain by shale or sandstone
- near coal or peat deposits
- near oil fields

Another common source of hydrogen sulphide is the magnesium corrosion control rod present in many hot water heaters. It can chemically reduce naturally occurring sulphates to hydrogen sulphide.

An ion exchange treatment unit (water softener) is another possible contributor to the odour problem. The softened water is more corrosive, increasing the rate at which the magnesium rod is dissolved. This dissolved magnesium provides an energy source (food) to the sulphate-reducing bacteria, accelerating the rate at which hydrogen sulphide is produced and thereby increasing odour complaints.

## QUICK FACTS

- Hydrogen sulphide gas may be found naturally in groundwater or may be related to a water treatment unit or the corrosion control rod of a hot water heater.
- Hydrogen sulphide gas has a noticeable smell, which may affect the taste of drinking water.
- Hydrogen sulphide can be detected through special laboratory testing.
- The Canadian drinking water quality guideline for hydrogen sulphide is an Aesthetic Objective (AO) of less than or equal to **0.05 mg/L**.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Aesthetic Objective for Drinking Water

Aesthetic objective for drinking water ≤ 0.05 mg/L

Hydrogen sulphide at concentrations above 0.05 mg/L may affect the taste, smell, or colour of well water.

The Canadian drinking water quality guideline for hydrogen sulphide is an Aesthetic Objective (AO) of less than or equal to **0.05 milligrams per litre (mg/L)**.

## Health Risks

Drinking water with hydrogen sulphide in very high concentrations can cause nausea, vomiting, and stomach pain. It is unlikely that a person would consume a harmful dose of hydrogen sulphide from drinking water, because of its unpleasant taste and odour.

Elevated hydrogen sulphide levels in groundwater may indicate that water quality problems exist that may cause other health problems.

Hydrogen sulphide can

- corrode metals such as iron, steel, copper, and brass
- tarnish silverware
- discolour copper and brass utensils
- cause yellow or black stains on fixtures
- discolour beverages made with water containing it
- alter the appearance and taste of cooked foods

## Testing

If you suspect hydrogen sulphide is present in your well water, contact an accredited water testing laboratory. A specific laboratory test is necessary to identify hydrogen sulphide in well water. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If hydrogen sulphide is present above 0.05 mg/L in the first test, you should determine the source of the hydrogen sulphide.

Hydrogen sulphide is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although hydrogen sulphide does not pose a serious health risk, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality that may cause adverse health effects.

- Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the hydrogen sulphide is present in the groundwater or a source inside the building, such as a water heater.
- Inspect the well construction.

Sulphate-reducing bacteria convert naturally-occurring sulphate in water into hydrogen sulphide. Since sulphate-reducing bacteria are a common source of hydrogen sulphide, treatment to control this should be tried first. See our fact sheet on iron and sulphur bacteria for more information.

If the hydrogen sulphide is only present in the household hot water, the magnesium rod in the water heater may be the cause of the odour problem. The purpose of the magnesium rod is to prevent corrosion of the water heater. Removing or replacing the magnesium rod may reduce the odour. Consult a qualified plumber before making any adjustments to the water heater.

If the source of hydrogen sulphide does not pose health concerns, treating your water is optional. You may choose to treat your water to improve the taste, smell, or colour and make it more pleasing to consume.

## Treatment

Effective treatment options include

- adsorption
- aeration
- chlorination and filtration
- chlorination and activated-carbon filter
- greensand filtration
- oxidation and filtration

Buy a treatment system that has been certified to meet the current NSF standards for hydrogen sulphide reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

If the hydrogen sulphide odour is strong when the water is first turned on in both the hot and cold water faucets and is more or less constant, the problem is likely to be hydrogen sulphide gas in the groundwater.

If hydrogen sulphide odour occurs in treated water (softened or filtered), and diminishes after a while or no hydrogen sulphide is detected in the non-treated water, it usually indicates the presence of some form of sulphate-reducing bacteria in the system.

If the hydrogen sulphide odour only occurs in the hot water, the problem is likely the magnesium rod in the hot water heater.

High concentrations of dissolved hydrogen sulphide can foul the resin bed of an ion exchange treatment unit (water softener).

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
1-877-9ENVIRO
or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Iron

**Iron (Fe)** is a metallic element present in many types of rock and is commonly found in water. It is also an essential element, required in small amounts, by all living organisms.

## Sources

The most common sources of iron in groundwater are naturally occurring and can be attributed to weathering of iron bearing rocks and minerals such as amphiboles, ferromagnesian micas, iron sulphides, magnetite, oxides, carbonates, and iron clay minerals. Other sources of iron in water can be attributed to human activities including mining activities, leachate from landfills and sewage effluent.

In drilled wells, iron often occurs naturally and is more commonly found in a dissolved form. Well components such as the casing, piping, pump parts, storage tanks, and other objects of cast iron or steel may also contribute to the concentration of iron in well water.

## QUICK FACTS

- Iron occurs naturally through the weathering of rocks and minerals and is commonly found in groundwater and surface water in Nova Scotia.
- Iron can be detected through chemical testing.
- The Canadian Drinking Water Quality Guideline for iron is an Aesthetic Objective of **0.3 mg/L**.
- Health effects are not expected at levels normally found in drinking water.
- The presence of iron in drinking water can affect the taste, smell, or colour of the water and can result in staining of laundry and bathroom fixtures.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Aesthetic Objective for Drinking Water

Aesthetic Objective (AO) concentration for drinking water = 0.3 mg/L

Iron at concentrations above the Canadian Drinking Water Quality Guideline Aesthetic Objective (AO) of **0.3 milligrams per litre (mg/L)** may affect the taste, smell, or colour of water.

## Health Risks

Health effects are not expected at levels normally found in drinking water.

Water with a high concentration of iron may cause the staining of plumbing fixtures or laundry. Iron can collect and block pipes or fixtures and produce rust flakes in water. It can also increase the growth of unwanted bacteria that form a slimy coating in water pipes. See our fact sheet on iron and sulphur bacteria for more information.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including iron. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at https://novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

The cost for the bacterial and chemical contaminant tests vary depending on the laboratory and the contaminants you choose to test for.

Special bottles and instructions on proper sampling should be obtained directly from the laboratory selected to complete the analysis.

## Solutions

If iron is present above 0.3 mg/L it is recommended that a second confirmatory test is completed.

If iron is confirmed to be present above the AO consider the following actions:

- Inspect and properly maintain the well
- Consider an alternate source or treat the current source to reduce iron levels.

## Treatment

Treatment systems include point-of-entry systems and point-of-use systems.

Effective treatment methods for reducing iron levels in drinking water include:

- aeration followed by filtration
- cation exchange
- distillation
- catalyzed oxidization/filtration, (including birm units and greensands filtration)
- reverse osmosis
- Some pitcher-style filtration units that incorporate the above methods may be effective.

Treatment systems certified by NSF for the applicable parameter are recommended when available. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org .

The effectiveness of treatment depends on the type of iron present, the pH of the water, and the parameter's relative concentration.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications Water Treatment Options and Maintaining Your Water Treatment, part of the Your Well Water booklet series at https://www.novascotia.ca/nse/water/privatewells.your.wellwater.asp .

## Considerations

The concentration of iron in well water can fluctuate seasonally and vary with the depth and location of the well and the geology of an area.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Lead

***Maximum acceptable concentration for drinking water = 0.005 mg/L***

**Lead (Pb)** is a naturally occurring element. The main source of lead in drinking water is through contact with plumbing materials with lead components such as lead solder and older brass fittings.

## Sources

Lead is naturally found in some types of bedrock. However, naturally occurring lead is rarely found dissolved in drinking water sources. The main source of lead in drinking water is through corrosion of plumbing materials with lead or brass components, such as in some pipes, solder, faucets, fittings, and older galvanized well liners.

The amount of lead dissolved into drinking water depends on factors such as pH, alkalinity, water temperature, water hardness, content of lead in plumbing materials and the amount of time water is left in pipes.

## Acceptable Concentration

In water, dissolved lead has no taste, smell, or colour. It can only be detected through a chemical test.

The Canadian drinking water quality guideline for lead is **0.005 milligrams per litre (mg/L) however every effort should be made to maintain lead levels as low as possible as there is no safe level of lead exposure.**

## QUICK FACTS

- The main source of lead in drinking water is through corrosion of plumbing materials.
- Lead in drinking water has no taste, smell, or colour.
- Lead can only be detected through chemical testing.
- The Canadian drinking water quality guideline for lead is **0.005 mg/L**.
- Exposure to lead in drinking water can cause health effects including: damage to the brain and nervous system, behavioural problems, reductions in IQ, learning disabilities, cardiovascular effects, kidney dysfunction and reproductive issues
- Well water with lead levels greater than **0.005 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If lead is present above 0.005 mg/L in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Lead in drinking water can cause a variety of adverse health effects. Children, infants, and unborn children are more strongly affected by exposure to lead because their bodies absorb lead more readily than adults. Children's brains and nervous systems are also more sensitive to the effects of lead.

Children exposed to lead can suffer from

- damage to the brain and nervous system
- behavioural and learning disabilities
- reduction in IQ scores
- delays in physical and mental development

Health effects for adults exposed to lead may include

- increased blood pressure
- increased risk of heart disease
- kidney damage
- anaemia
- digestive problems
- nerve disorders
- memory loss
- muscle and joint pain
- fatigue
- irritability
- headaches
- reproductive health impacts
- risk of cancer

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with lead levels greater than 0.005 mg/L may be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including lead. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If lead is present above 0.005 mg/L in the first test, you should determine the source of the lead. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the lead is present in the groundwater or the plumbing materials. While you are waiting for your test results, find an alternate source of water for drinking, cooking, and teeth brushing that has been tested and found to be safe.

If the source of lead is corrosion of lead-containing plumbing materials, consider the following options:

- Remove the source of lead.
- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust pH so water is less corrosive (for more information, see our fact sheets on pH and corrosive water).
- Use a treatment system to reduce lead levels.
- Use alternative water sources, such as bottled water or another well that has been tested and found to be safe.

## Treatment

Lead cannot be removed from water through boiling. Boiling water may increase the concentration of lead.

If the groundwater is found to have high levels of lead before entering the home, flushing the faucet will not be effective. Consider the following treatment systems to reduce lead levels:

- adsorption filters using carbon or specific types of resin
- distillation
- reverse osmosis
- water pitchers

Buy a treatment system that has been certified to meet the current NSF 53 standards for lead reduction. Reverse osmosis units should be certified to NSF 58 (which includes lead reduction). NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Filtration devices will lose their efficacy over time, therefore it is important to maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water. More frequent testing is also recommended to verify treatment performance.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment*, part of the Your Well Water booklet series at www.novascotia.ca/nse/water/privatewells.asp .

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Manganese

***Maximum acceptable concentration for drinking water = 0.120 mg/L***

**Manganese (Mn)** is a naturally occurring essential element found widely in air, water and soil. It is prevalent across Nova Scotia in surface water and groundwater.

## Sources

Manganese is likely to be found in groundwater and surface water throughout Nova Scotia at variable concentrations depending on the rock and soil in the area.

The most common sources of manganese in drinking water are naturally occurring and can be attributed to weathering of manganese bearing rocks and soils. Other less common sources of manganese can be attributed to human activities including mining and industrial activities, leachate from landfills and sewage effluent.

## Acceptable Concentration

The Guidelines for Canadian Drinking Water Quality has established a **maximum acceptable concentration (MAC) of 0.120 milligrams per litre (mg/L) and an aesthetic objective (AO) of 0.020 mg/L**.

## Health Risks

Current evidence indicates that consumption of manganese in drinking water above the MAC over a prolonged period of time can adversely affect neurologic development in children, and memory, attention and movement in adults.

## QUICK FACTS

- Manganese occurs naturally in groundwater and surface water throughout Nova Scotia
- Manganese can be detected through chemical testing
- The Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (MAC) for manganese is **0.120 mg/L**.
- Prolonged consumption of water with manganese above MAC levels may result in adverse neurological health effects
- The presence of manganese at concentrations above Aesthetic Objective levels of **0.020 mg/L** may affect the taste, smell or colour of water and possibly cause staining of laundry and bathroom fixtures.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Aesthetic Objective

The Aesthetic Objective (AO) for manganese is 0.020 mg/L, based on objectionable taste, smell and colour of the water as well as possible staining of laundry and bathroom fixtures.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including manganese. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at https://www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

The cost for the bacterial and chemical contaminant tests vary depending on the laboratory and the contaminants you choose to test for.

Special bottles and instructions on proper sampling should be obtained directly from the laboratory selected to complete the analysis.

## Solutions

If manganese is present above 0.120 mg/L it is recommended that a second confirmatory test is completed.

If manganese is confirmed to be present above the MAC consider the following actions:

- Inspect and properly maintain the well
- Find an alternate source for drinking, cooking, and teeth brushing, such as bottled water, or
- Treat your current source to reduce manganese levels.

If the concentration is above the AO, consider treatment to improve the aesthetic quality of the water.

## Treatment

Manganese cannot be removed from water through boiling. Boiling water may increase the concentration of manganese.

Treatment systems include point-of-entry systems and point-of-use systems.

Effective treatment methods for reducing manganese levels in drinking water include

- cation exchange
- distillation
- catalyzed oxidation / filtration
- reverse osmosis
- some pitcher-style filtration units that incorporate the above methods may be effective.

Treatment systems certified by NSF for the applicable parameter are recommended when available. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org .

The effectiveness of treatment depends on the type of manganese present, the pH of the water, and the parameter's relative concentration.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the Your Well Water booklet series at https://www.novascotia.ca/nse/water/privatewells.your.wellwater.asp .

## Considerations

The concentration of manganese in well water can fluctuate seasonally and vary with the depth and location of well and the geology in the area.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Nitrate

***Maximum acceptable concentration for drinking water = 10 mg/L***

**Nitrate ($NO_3$-)** is a naturally occurring chemical made of nitrogen (N) and oxygen (O).

## Sources

Nitrogen and nitrogen compounds, such as nitrate, are found in air, soil, water, and plants.

In groundwater, nitrate primarily comes from decomposing plant and animal material, agricultural fertilizers, manure, and domestic sewage.

Groundwater wells can be contaminated by

- leaching of chemical fertilizers
- leaching of animal manure
- improperly treated septic and sewage discharges

Vegetables are one of the main sources of ingested nitrate.

## Acceptable Concentration

In water, nitrate has no taste, smell, or colour. It can only be detected through a chemical test.

The Canadian drinking water quality guideline for nitrate depends on the method the laboratory uses to measure nitrate concentrations in water:

- **nitrate measured directly = 45 milligrams per litre (mg/L)**
- **nitrate-nitrogen calculated from the total nitrogen concentration = 10 milligrams per litre (mg/L)**

## QUICK FACTS

- Primary nitrate sources in well water include septic discharges and agricultural nutrients, such as fertilizers.
- Nitrate in drinking water has no taste, smell, or colour.
- Nitrate can only be detected through chemical testing.
- The Canadian drinking water quality guideline for nitrate-nitrogen is **10 mg/L**.
- Nitrate-nitrogen levels greater than **10 mg/L** in drinking water can pose a potentially fatal risk to infants under six months old.
- Well water with nitrate-nitrogen levels greater than **10 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If nitrate is present above the guideline limit in drinking water, consider alternative sources of water or water treatment options.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Nitrate-nitrogen levels greater than 10 mg/L can pose a risk to infants under six months old.

Infants who are fed water or formula made with water that contains a high concentration of nitrate can develop a condition called blue baby syndrome (methaemoglobinaemia). The infant's immature digestive system converts nitrate ($NO_3$-) to nitrite ($NO_2$-). Nitrite can diminish the oxygen-carrying capability of the infant's blood, causing the skin to turn a bluish colour. If the nitrate level in the water is very high, lack of oxygen may lead to death.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with nitrate-nitrogen levels greater than 10 mg/L may be used for bathing, handwashing, and dishwashing.

Elevated nitrate levels in groundwater may indicate other water quality problems, which may cause other health problems.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including nitrate. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If nitrate is present above the guideline limit in the first test, get a second test to confirm the original results. While you are waiting for your test results, find an alternate source of water for drinking, cooking, and teeth brushing that has been tested and found to be safe.

If nitrate is confirmed to be present above the guideline limit in the well water, determine the source of nitrate:

- Check the bacterial quality of the water.
- Inspect well construction and reconstruct the existing well, if necessary.

If bacterial quality and well construction are acceptable and no evidence of other contamination is found, you have the following options:

- Treat your current source of water to reduce nitrate levels.
- Use bottled water for drinking, cooking, and teeth brushing.

## Treatment

Nitrate cannot be removed from water through boiling. Boiling water may increase the concentration of nitrate.

Effective treatment methods include

- anion exchange
- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for nitrate reduction. NSF International is a

not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

Shallow wells, dug wells, improperly constructed wells, and damaged wells are most vulnerable to nitrate contamination.

Nitrate contamination is one of the first signs of deteriorating groundwater quality and could indicate other problems with well water quality.

## Considerations for anion exchange method

Nitrate is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. If other more preferred anions are present such as uranium, sulphate, or arsenic, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently to reduce the concentration of nitrate to a satisfactory level. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect nitrate treatment.

If the anion exchange unit is not properly maintained, the nitrate contained on the resin bed may rapidly detach, leading to higher levels of nitrate in the treated water than the untreated water. It is important to follow instructions for resin regeneration and replacement.

**Drinking Water Interpretation Tool (DWIT)**

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Nitrite

***Maximum acceptable concentration in drinking water = 1 mg/L***

**Nitrite ($NO_2$-)** is a naturally occurring chemical made of nitrogen (N) and oxygen (O).

## Sources

Nitrogen and nitrogen compounds, such as nitrite, are found in air, soil, water, and plants.

In certain conditions, when oxygen is unavailable, nitrate ($NO_3$-) may be converted to nitrite. Therefore many sources of nitrate are also potential sources of nitrite.

Sources of nitrite in groundwater include

- leaching of chemical fertilizers
- leaching of animal manure
- improperly treated septic and sewage discharges
- decaying plant or animal material
- erosion of natural deposits

One of the main sources of ingested nitrite originates from sodium nitrite used as a food preservative in cured meats, fish, and certain cheeses.

## Acceptable Concentration

In water, nitrite has no taste, smell, or colour. It can only be detected through a chemical test.

## QUICK FACTS

- Primary nitrite sources in well water include sources of nitrate, such as septic discharges and agricultural nutrients, such as fertilizers.
- Nitrite in drinking water has no taste, smell, or colour.
- Nitrite can only be detected through chemical testing.
- The Canadian drinking water quality guideline for nitrite-nitrogen is **1 mg/L**.
- Nitrite-nitrogen levels greater than **1 mg/L** in drinking water can pose a potentially fatal risk to infants under six months old.
- Well water with nitrite-nitrogen levels greater than **1 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If nitrite is present above the guideline limit in drinking water, consider alternative sources of water or water treatment options.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

The Canadian drinking water quality guideline for nitrite depends on the method the laboratory uses to measure nitrite concentration in water:

- **nitrite measured directly = 3 milligrams per litre (mg/L)**
- **nitrite-nitrogen calculated from the total nitrogen concentration = 1 milligram per litre (mg/L)**

## Health Risks

Nitrite-nitrogen levels greater than 1 mg/L can pose a risk to infants under six months old.

Infants who are fed water or formula made with water that contains a high concentration of nitrite can develop a condition commonly called blue baby syndrome (methaemoglobinaemia). Nitrite can diminish the oxygen-carrying capability of the infant's blood, causing the skin to turn a bluish colour. If the nitrite level in the water is very high, lack of oxygen may lead to death.

The risk to humans is through ingestion only – drinking, cooking, teeth brushing. Well water with nitrite-nitrogen levels greater than 1 mg/L may be used for bathing, handwashing, and dishwashing.

Elevated nitrite levels in groundwater may indicate other water quality problems, that can cause other health problems.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including nitrite. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If nitrite is present above the guideline limit in the first test, get a second test to confirm the original results. While you are waiting for your test results, find an alternate source of water for drinking, cooking, and teeth brushing that has been tested and found to be safe.

If nitrite is confirmed to be present above the guideline limit in the well water, determine the source of nitrite:

- Check the bacterial quality of the water.
- Inspect well construction and reconstruct the existing well, if necessary.

If bacterial quality and well construction are acceptable and no evidence of other contamination is found, you have the following options:

- Treat your current source of water to reduce nitrite levels.
- Use bottled water for drinking, cooking, and teeth brushing.

## Treatment

Nitrite cannot be removed from water through boiling. Boiling water may increase the concentration of nitrite.

Effective treatment methods include

- anion exchange
- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for nitrite reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Considerations

Shallow wells, dug wells, improperly constructed and damaged wells are most vulnerable to nitrite contamination.

Nitrite contamination may be a sign of deteriorating groundwater quality and could indicate other problems with well water quality.

## Consideration for anion exchange method

Nitrite is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. If other more preferred anions are present such as uranium, sulphate, arsenic, or nitrate, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently to reduce the concentration of nitrite to a satisfactory level. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect nitrite treatment.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# pH and Alkalinity

***Optimum range of ph is between 7.0 and 10.5***

The **pH level** of your drinking water is a measure of how acidic or basic it is – pH is related to the hydrogen ions in water and stands for "potential of hydrogen."

Alkalinity is a measure of the capacity of water to neutralize acids. It measures the presence of carbon dioxide, bicarbonate, carbonate, and hydroxide ions that are naturally present in water. At normal drinking water pH levels, bicarbonate, and carbonate are the main contributors to alkalinity.

## Sources

The pH and alkalinity of well water can be affected by

- natural geologic conditions at the site
- acid rain
- coal or other mining operations
- landfill, factory, gas station, or dry-cleaning operations
- water treatment processes

## QUICK FACTS

- pH is a measure of how acidic or basic water is.
- Alkalinity is a measure of the buffering capacity of water – its ability to resist sudden changes in pH.
- pH and alkalinity can be measured through testing at an accredited lab.
- There is no numerical Canadian drinking water quality guideline for **pH**, however the recommended operational guidance value is between **7.0 and 10.5**.
- There is currently no numerical Canadian drinking water quality guideline for alkalinity
- The control of pH is important to maximize treatment effectiveness, control corrosion and reduce leaching from distribution system and plumbing components.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Canadian Drinking Water Quality Guideline

### pH

pH is measured on a scale from 0 to 14:

- A measurement below 7 means the water is acidic.
- A measurement above 7 means the water is basic, or alkaline.
- A measurement of 7 is neutral.

The Canadian drinking water quality guideline recommendation for pH is **between 7 and 10.5**.

### Alkalinity

Alkalinity measures the concentrations of bicarbonate, carbonate, and hydroxide ions and is expressed as an equivalent concentration of calcium carbonate ($CaCO_3$).

No numerical Canadian drinking water quality guideline currently exists for alkalinity.

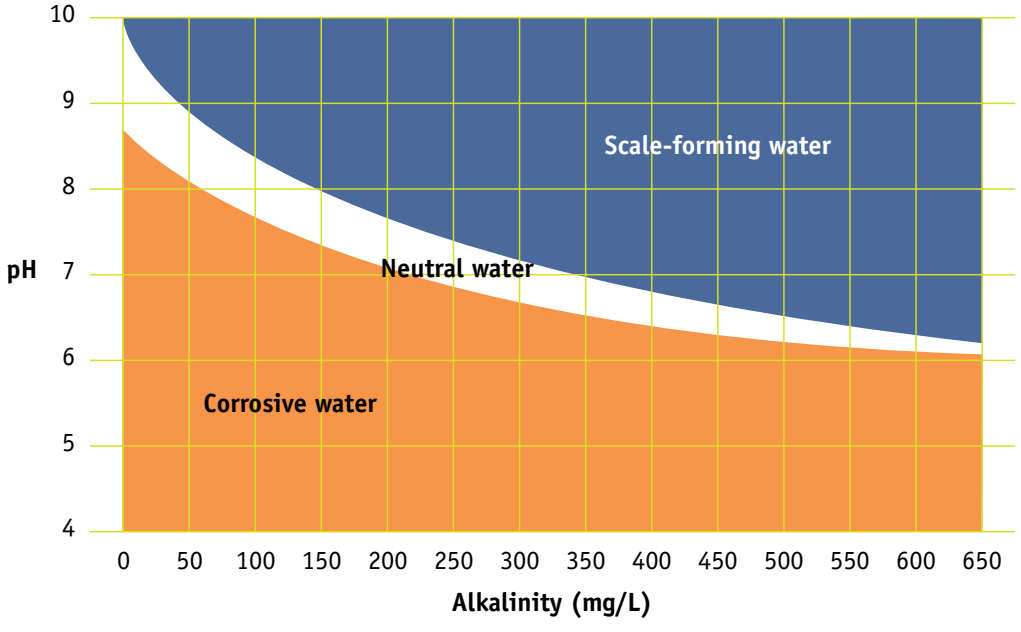
## pH and Alkalinity in Drinking Water

pH may interact with other factors, such as alkalinity, water temperature, total dissolved solids, and hardness to contribute to the corrosion of pipes and fixtures. See our fact sheet on hard water for more information.

While pH is not a health-risk in itself; corrosive water can dissolve metals, such as lead, cadmium, zinc, and copper, present in pipes. This may lead to increased concentrations of these metals in drinking water, which can cause health concerns (see our fact sheets on lead, cadmium, zinc, and copper for more information).

Figure 1 shows the relationship between pH and alkalinity and how they are factors in determining whether water is corrosive, scale-forming, or neutral.

Figure 1 • The relationship between pH, alkalinity, and water stability



## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including pH and alkalinity. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

PH may interact with other parameters to contribute to the corrosiveness of your water, or to cause your water to be scale-forming and contribute to incrustation.

Although pH does not pose serious health risks, a low pH may contribute to the corrosion of plumbing materials and the release of metals into the water, such as lead, cadmium, zinc, or copper. Get a metal scan done at an accredited water testing laboratory, because the presence of such metals in drinking water may pose health risks.

## Treatment Systems

One of the main purposes of adjusting pH is to minimize corrosion and incrustation in the water supply system. Both corrosion and incrustation can damage the water supply system.

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF certification is an internationally recognized safety standard. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although, there are currently no units certified specifically for pH adjustments, several treatment options can adjust pH to the optimum range of between 7.0 and 10.5:

- acid neutralizing filters
- ion exchange units
- chemical feed pump systems with a neutralizing solution

When choosing a treatment system to minimize corrosion, you should consider both the pH and alkalinity of water, since alkalinity is a measure of the buffering capacity of water – its ability to resist sudden changes in pH.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

## Considerations

Acid neutralizing filters, which use natural minerals, such as calcite, typically only raise pH by 1 to 2 units. They are not as effective in raising pH when water contains excessive levels of total dissolved solids. Advantages of these filters include low operation and maintenance costs. These filters may also increase hardness. See our fact sheet on hardness for more information.

Chemical feed treatment systems require very careful operation and maintenance. If soda ash is used as the neutralizing solution with a chemical feed pump, the sodium content of the water may increase. This may be a concern for those following a sodium-restricted diet. See our fact sheet on sodium for more information.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment
and Climate Change at
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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Potassium

**Potassium (K)** is an element commonly found in soils and rocks.

## Sources

Sources of potassium include

- weathering and erosion of potassium-bearing minerals, such as feldspar
- leaching of fertilizer
- sea water, in areas susceptible to saltwater intrusion

The most common source of potassium in drinking water are water treatment systems, such as ion exchangers (water softeners) that use potassium chloride.

## Aesthetic Objective for Drinking Water

No numerical Canadian drinking water quality guideline exists for potassium.

In water, potassium has no smell or colour, but may give water a salty taste.

## QUICK FACTS

Potassium is present in rock and soil.

- The most common source of potassium in drinking water are water softeners using potassium chloride.
- Potassium can only be detected through chemical testing.
- No numerical Canadian drinking water quality guideline exists for potassium.
- Potassium is an essential nutrient.
- Potassium in drinking water does not pose a health risk for healthy people.
- Potassium may cause health effects in people with certain conditions.
- If water is softened by potassium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Potassium is an essential nutrient for humans. Adverse health effects from exposure to increased potassium in drinking water are unlikely in healthy people.

People with kidney disease or conditions such as heart disease, coronary artery disease, hypertension, diabetes, and those who are taking medication that interferes with the way the body handles potassium may want to discuss concerns related to potassium intake from drinking water with their doctor.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including potassium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

Potassium is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although potassium does not pose a health risk for healthy individuals, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality, which may cause adverse health effects.

Potassium is present in all groundwater in Nova Scotia. If you notice a significant increase in potassium levels in the well water, investigate the source of potassium in drinking water. Consider the following options:

- Take a sample of water from the well before it is treated. This will help determine whether the source of potassium is the groundwater or the water treatment system.
- If the potassium is from surface sources, such as the leaching of fertilizer, it may indicate the presence of pathogens, or other contaminants present in surface water, which may cause adverse health effects:
- Test your well water for other contaminants, including bacteria.
- Inspect the well construction.
- Consider drilling a new well with proper site selection and construction to prevent contamination.
- Use water conservation measures, particularly in coastal areas, especially in summer months when groundwater recharge is lowest, to reduce the risk of saltwater intrusion.

When the source of potassium does not pose a health risk, treating your water is optional. You may choose to treat your water to improve the taste and make it more pleasing to consume.

When the source of potassium is from surface sources and other contaminants, including bacteria, are present, consider well construction improvements or water treatment options.

## Treatment

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for potassium reduction, effective treatment methods for reducing potassium levels in drinking water include

- distillation
- reverse osmosis

Once a system is installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

If water is softened by potassium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Selenium

***Maximum acceptable concentration in drinking water = 0.05 mg/L***

**Selenium (Se)** is found naturally in small quantities in rocks and soils.

## Sources

The presence of selenium in well water depends on the rock and soil type in the area. It may be more prevalent in areas underlain by certain shales. Weathering and erosion in these areas can lead to the presence of selenium in groundwater.

Other sources of selenium in groundwater include contamination from

- copper and lead refinery effluent
- municipal wastewater
- hazardous waste sites

For most people, food is one of the main sources of ingested selenium.

## Acceptable Concentration

In water, selenium has no taste, smell, or colour. It can only be detected through a chemical test.

The Canadian drinking water quality guideline for selenium is **0.05 milligrams per litre (mg/L)**.

## Health Risks

Selenium, at low levels, is an essential nutrient for human health.

Short-term exposure (over days or weeks) to selenium in drinking water at very high concentrations (above 9 mg/L) can cause nausea, diarrhea, vomiting, fatigue, and irritability.

## QUICK FACTS

- Selenium is present in rock, soil, and the effluent of certain industries.
- Selenium in drinking water has no taste, smell, or colour.
- Selenium can only be detected through chemical testing.
- The Canadian drinking water quality guideline for selenium is **0.05 mg/L**.
- Exposure to very high levels of selenium (above 9 mg/L) in drinking water can cause fatigue and irritability, as well as damage to hair, fingernails, and liver tissue.
- Well water with selenium greater than **0.05 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If selenium is present above **0.05 mg/L** in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

Long-term exposure (over years or decades) to selenium concentrations above 0.05 mg/L in drinking water may cause

- hair and fingernail damage
- damage to liver tissue

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with selenium levels greater than 0.05 mg/L may safely be used for bathing, handwashing, dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including selenium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If selenium is present above 0.05 mg/L in the first test, get a second test to confirm the original results.

If selenium is confirmed to be present above 0.05 mg/L in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or another well that has been tested and found to be safe.

or

- Treat your current source of water to reduce selenium levels.

## Treatment

Selenium cannot be removed from water through boiling.

Effective treatment methods include

- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for selenium reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Sodium

**Sodium (Na)** is highly soluble and often found naturally in groundwater. It is present in most rocks and soil and in many foods.

## Sources

All groundwater contains some sodium, because most rocks and soils contain sodium compounds from which sodium is easily dissolved.

An increase in sodium in groundwater above natural levels may indicate pollution or saltwater intrusion.

The most common sources of elevated sodium levels in groundwater are

- erosion of salt deposits and sodium bearing rock minerals
- naturally occurring brackish water of some aquifers
- water softener backwash
- saltwater intrusion into wells in coastal areas
- infiltration of surface water contaminated by road salt
- irrigation and precipitation leaching through soils high in sodium
- groundwater pollution by sewage effluent
- infiltration of leachate from landfills or industrial sites

## QUICK FACTS

- All groundwater naturally contains some sodium.
- Human activities can also be sources of sodium in well water.
- In water, sodium has no smell or colour, but can give water a salty taste.
- Sodium can be detected through chemical testing.
- The Canadian drinking water quality guideline for sodium is an Aesthetic Objective (AO) of less than or equal to **200 mg/L**.
- Sodium in drinking water may cause health concerns for those on sodium-restricted diets.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Aesthetic Objective for Drinking Water

Aesthetic objective for drinking water ≤ 200 mg/L

The Canadian drinking water quality guideline for sodium is an Aesthetic Objective (AO) of less than or equal to **200 milligrams per litre (mg/L)**.

In water, sodium has no smell or colour, but it can be tasted by most people at concentrations above 200 mg/L.

## Health Risks

Sodium is an essential ion in bodily fluids. It is not harmful at normal levels of intake from combined food and drinking water sources. Drinking water is generally a minor source of total sodium intake; however, increased intake of sodium may cause problems for people on low sodium diets, such as those with hypertension, heart disease, or kidney problems.

People on sodium-restricted diets may want to discuss concerns related to sodium intake from drinking water with their doctor.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including sodium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under “laboratories.”

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If sodium is present above 200 mg/L in the first test, get a second test to confirm the original results.

Sodium is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although sodium does not pose a health risk for healthy individuals, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality, which may cause adverse health effects. Where present in association with chloride, sodium may contribute to corrosion.

If sodium is confirmed to be present above 200 mg/L in the well water, investigate the source of sodium in drinking water. Consider the following:

- If the sodium is from surface sources, such as irrigation or sewage discharges, it may indicate the presence of pathogens or other contaminants present in surface water, which may cause adverse health effects:
- Test your well water for other contaminants, including bacteria.
- Inspect the well construction.
- Consider drilling a new well with proper site selection and construction to prevent contamination.

- If you use road salt on your property, handle, store, and use it properly to minimize groundwater contamination.
- Use water conservation measures, particularly in coastal areas, especially in summer months when groundwater recharge is lowest, to reduce the risk of saltwater intrusion.

When the source of sodium does not pose a health risk, treating your water is optional. You may choose to treat your water to improve the taste and make it more pleasing to consume.

When the source of sodium is from surface sources and other contaminants, including bacteria, are present, consider well construction improvements or water treatment options.

## Treatment

Sodium cannot be removed from water through boiling, chlorination, or pitcher-type filtration. Boiling may increase sodium concentrations.

Effective treatment methods to reduce sodium levels include

- distillation
- reverse osmosis

Buy a treatment system that has been certified to meet the current NSF standards for sodium reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

If water is softened by sodium ion exchange, you should use a separate, unsoftened supply of water for cooking and drinking.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Strontium

***Maximum acceptable concentration for drinking water = 7.0 mg/L***

**Strontium (Sr) is a naturally occurring element** found widely in soil, food, water and certain consumer products such as glass, aluminum alloys, paint, electrical applications, signaling devices and fireworks.

## Sources

Strontium can occur naturally in groundwater and surface water sources through the weathering of rocks and soils or as a result of human activities such as mining and manufacturing operations.

## Acceptable Concentration

The Guidelines for Canadian Drinking Water Quality has established a **maximum acceptable concentration (MAC) of 7.0 milligrams per litre (mg/L)**.

## Health Risks

Current evidence indicates that consumption of strontium in drinking water above the MAC over a prolonged period of time can lead to adverse effects on bone development and may lead to rickets. Symptoms of rickets include weakened or softened bones, stunted growth, and/or bone deformities.

Infants are most susceptible to the effects of high levels of strontium because their bones are actively developing.

## QUICK FACTS

- Strontium can occur naturally in groundwater and surface water.
- Strontium in drinking water has no taste, smell, or colour.
- Strontium can only be detected through chemical testing.
- The Guidelines for Canadian Drinking Water Quality Maximum Acceptable Concentration (MAC) for strontium is **7.0 mg/L**.
- Exposure to elevated levels of strontium in drinking water can cause adverse effects to bone development.
- Water with strontium levels greater than 7.0 mg/L should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If strontium is present above 7.0 mg/L in drinking water, consider water treatment options or alternative sources of water.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Bathing and showering in water that contains strontium should not pose a health risk.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including strontium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or look for "laboratories" in the Yellow Pages.

The cost for the bacterial and chemical contaminants tests vary depending on the laboratory and the contaminants you choose to test for.

Get the special sampling bottles and instructions on proper sampling from the laboratory.

## Solutions

If strontium is present above 7.0 mg/L it is recommended that a second confirmatory test is completed.

If strontium is confirmed to be present above the MAC, consider the following actions:

- Inspect and properly maintain the well
- Find an alternate source for drinking, cooking, and teeth brushing, such as bottled water
- Treat your current source to reduce strontium levels.

## Treatment

Strontium cannot be removed from water through boiling. Boiling water may increase the concentration of strontium.

Effective treatment methods for reducing strontium levels in drinking water include:

- reverse osmosis
- ion exchange

Reverse osmosis treatment systems should only be used at a point-of-use (i.e. the tap) because treated water may be corrosive to internal plumbing when installed at a point-of-entry.

Treatment systems certified by NSF for the applicable parameter are recommended when available. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options and Maintaining Your Water Treatment*, part of the Your Well Water booklet series at https://www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

### Drinking Water Interpretation Tool (DWIT)

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NOVA SCOTIA

# Sulphate

**Sulphate ($SO_4^{2-}$)** is a combination of sulphur (S) and oxygen (O). It occurs naturally in many soil and rock formations.

## Sources

In groundwater, most sulphates are generated from the dissolution of minerals, such as gypsum and anhydrite.

Saltwater intrusion and acid rock drainage are also sources of sulphates in drinking water.

Man-made sources include industrial discharge and deposition from burning of fossil fuels.

## Aesthetic Objective for Drinking Water

Aesthetic Objective for Drinking Water ≤ 500 mg/L

The Canadian drinking water quality guideline for sulphate is an Aesthetic Objective (AO) of less than or equal to **500 milligrams per litre (mg/L)**.

Sulphate in water may produce a noticeable taste at higher concentrations.

## QUICK FACTS

Sulphate is found naturally in groundwater through the weathering of rocks.

- Human activities can also be sources of sulphate in well water.
- Sulphate may give water a noticeable taste and may cause corrosion of pipes.
- Sulphate can be detected through chemical testing.
- The Canadian drinking water quality guideline for sulphate is an Aesthetic Objective (AO) of less than or equal to **500 mg/L**.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Sulphate present above 500 mg/L in water may affect the taste of water. At levels above 1000 mg/L, sulphate in drinking water can have a laxative effect, although these levels are not normally found in drinking water.

Sulphate minerals in drinking water can increase corrosion of plumbing and well materials. Sulphur bacteria may produce a dark slime or deposits of metal oxides that develop as a result of the corrosion of metal pipes. The slime or deposits can clog plumbing and stain clothing. See our fact sheet on iron and sulphur bacteria for more information.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including sulphate. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If sulphate is present above 500 mg/L in the first test, get a second test to confirm the original results.

Sulphate is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although sulphate does not pose a health risk at levels normally found in drinking water, its presence can indicate deteriorating groundwater quality and could indicate other problems with well water quality, which may cause adverse health effects.

If sulphate is confirmed to be present above 500 mg/L in the well water, investigate the source of sulphate in drinking water. Consider the following:

- If the sulphate is from surface sources, such as industrial discharges, it may indicate the presence of pathogens or other contaminants present in surface water, which may cause adverse health effects:
- Test your well water for other contaminants, including bacteria.
- Inspect the well construction.
- Consider drilling a new well with proper site selection and construction to prevent contamination.
- Use water conservation measures, particularly in coastal areas, especially in summer months when groundwater recharge is lowest, to reduce the risk of saltwater intrusion.

When the source of sulphate does not pose a health risk, treating your water is optional. You may choose to treat your water to improve the taste and make it more pleasing to consume.

When the source of sulphate is from surface sources and other contaminants, including bacteria, are present, consider well construction improvements or water treatment options.

## Treatment

Sulphate cannot be removed from water through boiling.

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for sulphate reduction, effective treatment methods for reducing sulphate levels in drinking water include

- anion exchange
- distillation
- reverse osmosis

The effectiveness of these methods may depend on

- the volume of water to be treated
- the concentration of sulphate in the water
- the presence of other chemical parameters in the water
- whether bacterial contamination is a concern

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations for Anion Exchange Method

Sulphate is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. Sulphate is preferred over arsenic, nitrate, nitrite, and fluoride. If you need to reduce the levels of these anions when sulphate is present, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect treatment.

The presence of sulphate may cause any arsenic, nitrate, nitrite, or fluoride contained on the resin bed to rapidly detach, leading to higher levels in the treated water than the untreated water. It is important to follow instructions for resin regeneration and replacement when sulphate is present.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Turbidity

**Turbidity** refers to the cloudiness or degree of clarity of the water.

## Sources

Turbidity in drinking water can be naturally occurring. It is caused by suspended matter, such as silt, clay, fine organic and inorganic matter, and by microorganisms.

Turbidity is always present in surface water sources no matter how clear the water looks.

In groundwater, turbidity is common due to natural geology. Turbidity may also be caused by the following:

**Elements present in the water supply pipes, such as iron and manganese** – See our fact sheet on iron and manganese for more information.

**Poor well construction** – This allows surface water to enter the well. Poor well construction is more likely to be the cause of turbidity when bacteria are also found to be present.

**Recent shock chlorination of the well or piping system** – Shock chlorination is a common treatment method which involves flushing the water system with large amounts of chlorine. If water remains turbid after two or three days of normal use following treatment, investigate the source of the turbidity.

**Overpumping or large water level changes in a well** – This disturbs sediment in the well and may cause the water to become turbid.

## QUICK FACTS

- Turbidity in water refers to its cloudiness or degree of clarity.
- Turbidity in drinking water can be from organic or inorganic sources.
- You should determine the source of turbidity to figure out if it is a health concern. This information also helps you choose the best solution for reducing turbidity and your treatment options.
- For surface water and some groundwater supplies, turbidity may indicate the presence of disease-causing organisms that can cause adverse health effects.
- Regularly test your well water for a standard suite of microbiological, chemical, and physical parameters, including turbidity.
- If you use a surface water supply, a turbidity level of 1.0 NTU or less is recommended . Above this level turbidity could affect disinfection and microbiological quality.
- If you use a groundwater well supply, a turbidity level of 1.0 NTU or less is recommended. Above this level turbidity could affect disinfection and microbiological quality.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical and physical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Recommendation for Drinking Water

Turbidity is measured in nephelometric turbidity units (NTU). Turbidity is a measurement of how light scatters when it is aimed at water and reflected from suspended particles in the water. It is not a measurement of the number of particles themselves. However, the more particles suspended in water, the more difficult it is for light to travel through it and the higher the turbidity, or cloudiness.

There is no numerical Canadian drinking water quality guideline for turbidity, but the recommendation is for turbidity to be less than 1.0 NTU. Turbidity above 5.0 NTU is likely noticeable and, even if not indicative of health related issues, may be objectionable to consume due to taste, smell or colour.

## Health Risks

You should know and understand the source of turbidity to deal with it appropriately. Whether there are health risks associated with turbidity often depends on the source.

### Surface water and wells with turbidity that **may cause** health problems

For surface water and for wells with turbidity that may cause health problems, turbidity is an indicator for the presence of disease-causing organisms, such as bacteria, viruses, and parasites. These organisms can cause nausea, cramps, and diarrhea.

### Wells with turbidity that is **not likely to cause** health problems

In groundwater sources with turbidity that is not likely to cause health problems, turbidity may be present due to the presence of inorganic matter, such as precipitates of iron and manganese from natural sources. These particles are not typically a health hazard in drinking water.

## Testing

Regularly test your well water for a standard suite of microbiological, chemical, and physical parameters, including turbidity. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under “laboratories.”

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $20 for a single parameter to $250 for a full suite of microbiological and chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

To find the best solution for reducing turbidity, follow recommendations based on the water supply source, as indicated below.

### Surface water

If you have a surface water supply, it is recommended the water should always be properly filtered and disinfected before it is consumed. See the Treatment section of this fact sheet for more information.

### Wells

Groundwater is naturally filtered in the subsurface and generally has low turbidity. However, if your well water has turbidity above 1.0 NTU, then additional sampling for bacteria and nitrates may help to determine whether the turbidity in your well water is likely to present a health risk or not.

## How Do I Know What Applies to Me?

First you need to determine what type of turbidity you have. This will help establish whether there are possible health effects. It will also help you find the best solution for reducing turbidity and the treatment options that may work.

If your water comes from a surface water supply, such as a lake or stream, it is important that water be properly treated using filtration and disinfection. See our fact sheet on surface water for more information at www.novascotia.ca/nse/surface.water/docs/SurfaceWaterQA.pdf.

For groundwater supplies, if turbidity levels are greater than 1.0 NTU and treatment is not used, or is ineffective, it is important to determine if turbidity is indicative of the presence of health related parameters. For this it is useful to also 1) test for bacteria and nitrates and 2) evaluate the well construction.

If you detect bacteria or nitrate in your well water, then the turbidity may further contribute to the risk of exposure to health related parameters. If this is the case, you should filter and disinfect the water before consuming it.

A turbidity value higher than 1.0 NTU may be acceptable if you find that the turbidity is not indicative of parameters that are a health concern. Turbidity is not indicative of a health concern if all of the following are true:

- bacteria are absent
- nitrate-nitrogen is less than 1 mg/L
- well construction is acceptable
- no evidence of other contamination is found

If all of the above are true, it is likely that the turbidity is caused by inorganic materials, such as precipitates of iron or manganese, or natural geology. The parameters in a standard suite of chemical and physical parameters may provide clues to the origins of the turbidity.

# Treatment

## Turbidity may cause health problems and requires treatment

Turbidity is an indicator that disease-causing organisms may be present and may cause health problems. All water supplies with turbidity should be properly treated. Proper treatment involves both filtration and disinfection.

**Filtration**

Turbidity can be removed by means of filtration. Filters are often rated by the average pore size. The smaller the pore size, the smaller the grain size the filter can remove. The finer the filter the sooner it will be coated with debris and the more often it will need to be cleaned or replaced.

Buy a treatment system that has been certified to NSF Standard 53 for reducing turbidity. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org. There are various point-of-use and point-of-entry filtration units certified to Standard 53. Units certified under this Standard are able to reduce turbidity from 11 NTU to 0.5 NTU.

**Disinfection**

Disinfection is needed when turbidity is associated with a positive bacteria test result. Disinfection options include distillation, chlorination, ozone or ultraviolet disinfection. An ultraviolet light unit purchased for the inactivation of pathogenic microorganisms should be certified to NSF Standard 55 Class A. Units without the Class A designation are only intended to be used for the reduction of non-pathogenic, nuisance organisms. Ultraviolet lights are intended for water that is visually clear (that is, not coloured, cloudy, or turbid). If the water is turbid, it should be filtered first to clarify the water.

## Treatment for turbidity that is **not likely to cause** health problems

If you have determined that the turbidity in your well water is not likely to cause health problems, you may choose to treat the water for aesthetic purposes. Basic filtration may be helpful in most cases. Other effective treatment methods include

- adsorption systems (such as carbon filtration)
- reverse osmosis

Buy a treatment system that has been certified to NSF Standard 53 or Standard 58 for reducing turbidity. Standard 53 certifies filtration units. Standard 58 certifies reverse osmosis systems. Units certified under both Standard 53 and Standard 58 are able to reduce turbidity from 11 NTU to 0.5 NTU. Reverse osmosis systems are certifed for point-of-use and should only be installed at the tap.

If turbidity is due to precipitates of iron and manganese due to high dissolved concentrations of these metals, additional options include

- aeration followed by filtration
- greensand filtration
- oxidizing filters, including birm units
- mechanical filtration by sand and gravel or other filtration media to trap suspended solids
- ion exchange

*See our fact sheet on iron and manganese for more information.*

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment*, part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.your.wellwater.asp.

## Considerations

When sampling, it is important not to overpump a well. Turbidity may increase with overpumping. As a result, the sample will not be representative of typical water conditions.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

FOR MORE INFORMATION CONTACT
Nova Scotia Environment and Climate Change at
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or 1-877-936-8476
www.novascotia.ca/nse/water

NOVA SCOTIA

# Uranium

***Maximum acceptable concentration for drinking water = 0.02 mg/L***

**Uranium (U)** is a naturally occurring radioactive element that exists in soil and rock throughout the world. Some areas of Nova Scotia have a greater potential for elevated uranium levels in drinking water. *See Figure 1*.

## Sources

Natural concentrations of uranium vary in Nova Scotia, depending on the type of minerals in the soil or bedrock. Wells most likely to have high levels of uranium are those in areas with granite, sandstone, and shale bedrock.

Naturally occurring uranium in groundwater comes from the dissolving of minerals that contain uranium. Elevated levels of uranium are more likely to be found in drilled wells that obtain their water through cracks and fractures in bedrock, than in dug wells or surface water supplies.

Some human activities are also sources of uranium – mill tailings, emissions from the nuclear industry, and the combustion of coal and other fuels.

## Acceptable Concentration

In water, uranium has no taste, smell, or colour. It can only be detected through a chemical test.

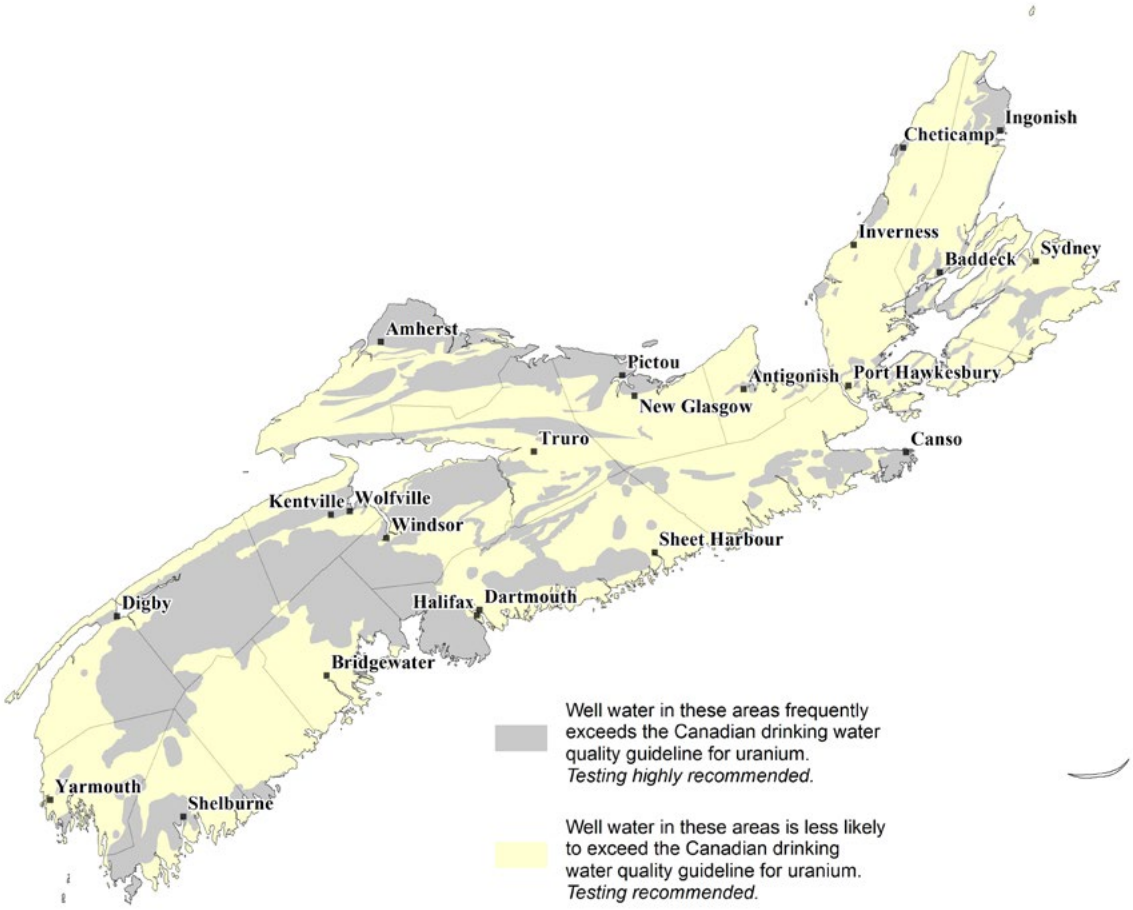
The Canadian drinking water quality guideline for uranium is **0.02 milligrams per litre (mg/L)**.

## QUICK FACTS

Naturally occurring uranium is likely to be found in groundwater in areas with granite, sandstone, and shale bedrock.

- Uranium in drinking water has no taste, smell, or colour.
- Uranium can only be detected through chemical testing.
- The Canadian drinking water quality guideline for uranium is **0.02 mg/L**.
- Exposure to uranium in drinking water can result in kidney damage.
- Well water with uranium levels greater than **0.02 mg/L** should not be used for drinking, cooking, or teeth brushing. It may be used for bathing, handwashing, and dishwashing.
- If uranium is present above **0.02 mg/L** in drinking water, consider alternative sources of water or water treatment options.

Figure 1 • Areas in Nova Scotia with naturally occurring uranium in groundwater




Source:
https://novascotia.ca/natr/meb/download/mg/ofm/htm/ofm_2009-007.asp

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Uranium levels in drinking water above 0.02 mg/L can increase the risk of kidney damage.

The risk to human health is through ingestion only – drinking, cooking, teeth brushing. Well water with uranium levels greater than 0.02 mg/L may be used for bathing, handwashing, and dishwashing.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including uranium. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If uranium is present above 0.02 mg/L in the first test, get a second test to confirm the original results.

If uranium is confirmed to be present above 0.02 mg/L in the well water,

- Find an alternate source of water for drinking, cooking, and teeth brushing, such as bottled water or a dug well that has been tested and found to be safe.

or

- Treat your current source of water to reduce uranium levels.

## Treatment

Uranium cannot be removed from water through boiling.

We recommend purchasing a treatment system that has been certified to meet the current NSF standards. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Although there are currently no treatment units certified specifically for uranium reduction, effective treatment methods for reducing uranium levels in drinking water include

- activated alumina
- anion exchange
- distillation
- reverse osmosis

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations for Anion Exchange Method

Uranium is a negative ion (anion) in solution. When you use anion exchange treatment, the resin in the unit will remove certain anions more readily than others. Uranium is preferred over sulphate, arsenic, nitrate, nitrite, and fluoride. If you need to reduce the levels of these anions when uranium is present, the effectiveness of the unit may be reduced. The resin in the anion exchange unit may need to be regenerated more frequently. It is important that a detailed chemical analysis of your water be completed to determine if other substances are present that will affect treatment.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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NOVA SCOTIA

# Zinc

**Zinc (Zn)** is a metal normally found in small amounts in nature.

## Sources

Although zinc occurs naturally, most zinc finds its way into groundwater because of human activities.

Galvanized liners or fittings or metal pipes coated with zinc, present in many older wells or plumbing systems, can leach zinc into drinking water.

Well water may also be contaminated through processes, such as

- mining
- lead-zinc smelters
- steel production
- coal burning
- hazardous waste disposal

## Aesthetic Objective for Drinking Water

Aesthetic objective for drinking water
≤ 5.0 mg/L

The Canadian drinking water quality guideline for zinc is an Aesthetic Objective (AO) of less than or equal to **5.0 milligrams per litre (mg/L)**.

Water containing zinc at concentrations above 5.0 mg/L tends to have a milky appearance (opalescent), develops a greasy film when boiled, and has an undesirable sharp taste. It may also leave a whitish residue on pipes and fixtures.

## QUICK FACTS

- Zinc is naturally occurring, but most zinc found in groundwater is due to human activities.
- Zinc can give water an undesirable taste and a milky appearance.
- Zinc can be detected through chemical testing.
- The Canadian drinking water quality guideline for zinc is an Aesthetic Objective (AO) of less than or equal to **5.0 mg/L**.
- To improve the aesthetic quality of drinking water, homeowners may consider water treatment options or use an alternative water source.

## Regular Testing

Homeowners are responsible for monitoring the quality of their private water supply:

- Test for bacterial quality every 6 months.
- Test for chemical quality every 2 years.
- Test more often if you notice changes in physical qualities – taste, smell, or colour.

Regular testing alerts you to problems with your drinking water.

## Health Risks

Zinc is an essential element and is generally considered to be non-toxic, but exposure to very high concentrations of zinc may result in nausea and diarrhea.

## Testing

Regularly test your well water for a standard suite of chemical parameters, including zinc. Use an accredited water testing laboratory. Find a list of accredited water testing laboratories at www.novascotia.ca/nse/water/waterlabs.asp or see the Yellow Pages under "laboratories."

Get the special sampling bottles and instructions on proper sampling from the laboratory.

The cost of analyzing water samples can range from $15 for a single parameter to $230 for a full suite of chemical parameters. The cost can vary depending on the lab and the number of parameters being tested.

## Solutions

If zinc is present above 5.0 mg/L in the first test, you should determine the source of the zinc. Get a second test, taking a sample of water from the well before it enters the building. This will help determine whether the zinc is present in the groundwater or the plumbing or well materials.

Zinc is an aesthetic parameter. Aesthetic parameters may impair the taste, smell, or colour of water. Although zinc does not pose serious health risks, if the source of zinc is corrosion of plumbing materials, be aware that other metals, such as lead or cadmium, may also be released into the water. Get a metal scan done at an accredited water testing laboratory, because the presence of other metals in drinking water may pose health risks.

If zinc is confirmed to be the only metal present above the guideline limit, the following options are available to make your water more pleasing to consume:

- Remove the source of zinc.
- Flush faucets until the water runs as cold as possible before using the water for drinking, cooking, or teeth brushing.
- Avoid using hot tap water for drinking, cooking, or making baby formula.
- Adjust the pH so water is less corrosive (for more information, see our fact sheets on pH and corrosive water).
- Use a treatment system to reduce zinc levels in your water.

## Treatment

Zinc cannot be removed from water through boiling. Boiling water may increase the concentration of zinc.

Effective treatment methods include

- adsorption
- cation exchange

Buy a treatment system that has been certified to meet the current NSF standards for zinc reduction. NSF International is a not-for-profit, non-governmental organization that sets health and safety standards for manufacturers in 80 countries. See its website at www.nsf.org.

Once installed, re-test your water to ensure the treatment system is working properly. Maintain the system according to the manufacturer's instructions to ensure a continued supply of safe drinking water.

For more information on water treatment, see our publications *Water Treatment Options* and *Maintaining Your Water Treatment,* part of the *Your Well Water* booklet series at www.novascotia.ca/nse/water/privatewells.asp.

## Considerations

Galvanized well liners are no longer allowed under the Well Construction Regulations and galvanized fittings are no longer allowed under the National Plumbing Code of Canada. Galvanized well liners or fittings may be present in older well or plumbing systems.

### Drinking Water Interpretation Tool (DWIT)

You can compare guidelines for many common drinking water quality parameters by entering your well water test results in the Nova Scotia Environment and Climate Change Drinking Water Interpretation Tool at: novascotia.ca/nse/dwit

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